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GEOLOGY
AND
MINERAL RESOURCES
OF
FAYETTE COUNTY
PENNSYLVANIA

BY

W. O. HICKOK IV AND F. T. MOYER

DEPARTMENT OF INTERNAL AFFAIRS
WILLIAM S. LIVENGOOD, JR., *Secretary*
TOPOGRAPHIC AND GEOLOGIC SURVEY
GEORGE H. ASHLEY, *State Geologist*
Harrisburg, Pa.
1940

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GEOLOGY AND MINERAL RESOURCES OF FAYETTE COUNTY, PENNSYLVANIA

By W. O. Hickok IV and F. T. Moyer

PART I. GENERAL GEOLOGY

INTRODUCTION

Location and area. Fayette County is in southwestern Pennsylvania along the southern boundary of the State. It is bounded on the south by Garrett County, Maryland, and Preston and Monongalia Counties, West Virginia, on the east by Somerset County, on the north by Westmoreland County, and on the west by Washington and Greene Counties. The southern boundary is the Mason and Dixon line; the eastern follows the Youghiogheny River in the south and the crest of Laurel Hill in the north; the northern follows County Line road across the mountains in the east and Jacobs Creek in the western lowlands; the western boundary is the Monongahela River. Fayette County has an area of 824 square miles, and ranks twentieth in size among the 67 counties of the State.

Importance of the mineral industries. The mineral industries are by far the most important group in Fayette County and they have largely determined the development of the county. The capital invested in the mineral industries represented roughly 80 per cent of the total industrial investment and the value of the mineral products approximately 75 percent of the total annual value of the industrial products of the county in 1928. By 1937 the business depression had reduced these figures to 60 and 56 percent respectively, counting only manufacturing and mineral production as industries.

The chief mineral industry is the mining of coal, and it represents 90 percent of the mineral production. Next in importance is the manufacture of beehive coke, which is now only of minor importance. The remaining mineral industries, which include the manufacture and production of ganister brick, building brick, other clay products, crushed stone, sand and gravel and natural gas, account for about 5 percent of the mineral industry of the county.

Field work and acknowledgments. The field work for this report was begun in 1930 by Mr. Stanley H. Cathcart of this Survey, who spent three and a half months in Fayette County in the late summer and fall of that year. He was assisted for one and a half months by Mr. H. S. Gibbs, one week by Mr. Edward R. Barnsley, and for three months by Mr. Forrest T. Moyer. In 1931 Mr. Cathcart returned for one month to the county. In 1932 Mr. Moyer spent two months and Dr. William O. Hickok 4th. spent slightly less than one month in Fayette County. During 1933 Dr. Hickok was placed in charge of the Fayette County investigations other than coal and spent two months there during the fall. Mr. Moyer was given charge of the coal resource investigations and spent four months in the county. Prof. Henry Leighton spent one week with Dr. Hickok investigating fire clay and Mr. Marchant N. Shaffner spent five weeks assisting Dr. Hickok in natural gas investigations. In 1934 Dr. Hickok spent four months in Fayette County; he was assisted for one and a half months by Mr. Shaffner. Mr. Moyer likewise spent four months in the county. Dr. Bradford Willard made paleontological investigations during the progress of the work.

The authors wish to extend their thanks to the many citizens of Fayette County who have aided them in their investigations, although it is not possible here to mention each of them individually. The H. C. Frick Coal & Coke Co., the Columbia Gas & Electric Co., the Carnegie Natural Gas Co., the Dunbar Corporation, the Vang Construction Co., the New Castle Lime and Stone Co., and many other operators in the natural resource industries deserve the thanks of the writers for their kindness and courtesy in contributing data and allowing inspection of their plants.

The writers also wish to acknowledge the cooperation of the U. S. Bureau of Mines, the Testing Laboratory of the Pennsylvania Department of Highways, and the many other State and Federal bureaus in forwarding specific phases of this investigation. Acknowledgment is also made of the helpful advice and criticism of the members of the Pennsylvania Geological Survey staff who are not mentioned above as having carried on investigations in the county, especially of Mr. Ralph W. Stone for his work in editing this report, and Miss M. M. Johnstone, who made all the drawings except Figs. 134-139.

Previous work. Geological investigations have been carried on in Fayette County for nearly a century (for more than a century if we include the exploration of Dulany Cave by John A. Paxton of Philadelphia on September 11, 1816). Henry D. Rogers visited the county and studied its geology in the preparation of his "Geology of Pennsylvania," which was published in 1858. Nearly twenty years after Rogers' report was completed the Second Pennsylvania Geological Survey began restudying the geology of the area. J. J. Stevenson was the geologist in charge and the results of his work were published in reports KK and KKK of that survey. Shortly after 1900 the United States Geological Survey (M. R. Campbell, geologist-in-charge) restudied the western part of the county and published the results in the "Geologic Atlas of the United States," folios numbers 82 and 94. Between that time and the present survey no official areal geologic work has been done in Fayette County, but some of the mineral resources of the county have been studied individually.

BIBLIOGRAPHY OF FAYETTE COUNTY GEOLOGY

Ashley, Geo. H., and Robinson, J. F., Oil and gas fields of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 1, 1922.

A general treatment of oil and gas in Pennsylvania. Discusses origin, general occurrence, oil and gas sands, structure of fields, production and life, reserves, and future outlook. The last part of the paper is devoted to descriptions of individual pools by counties. Fayette County has seven pools: Luzerne, Antrim Run, Waltersburg, Haddonville, Masontown, Fayette, New Geneva.

Ashley, Geo. H., Sisler, James D., and Reese, John F., Bituminous coal fields of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 6, parts I, II, III and IV, 1925-1928.

Part I. General information—general description of the individual coal beds. Distribution of coal in Fayette County, page 141. Fayette County contains nearly all the coals known in Pennsylvania. The main beds are: Pittsburgh, Redstone, Sewickley, Uniontown, Waynesburg, Waynesburg A, Washington, Upper Freeport, Upper and Lower Kittanning, Brookville-Clarion, and Mercer.
Part II. Detailed description of coal fields. Fayette County, pp. 201-252. Considerable detail given about the Pittsburgh coal, other beds only briefly discussed.
Part III. Coal resources. The coal resources of Pennsylvania are computed by townships and counties. Fayette County, pp. 86-94.
Part IV. Coal analyses. U. S. Bureau of Mines. Fayette County, pp. 76-84, 174-196. Gives detailed analyses of many coals and for some of them coal sections from the mines where sample was taken.

Butts, Chas., Loyalhanna limestone of southwestern Pennsylvania: Am. Jour. Sci., vol. 8, pp. 249-257, 1924.

Emphasizes the value of the Loyalhanna limestone and correlates it with the Ste. Genevieve of the Mississippi Valley. Considers Loyalhanna and overlying beds to be of Chester age, whereas the Burgoon (Pocono) correlates with the Logan sandstone and Burlington limestone. The Loyalhanna is correlated with the Ste. Genevieve on a lithologic and stratigraphic basis. No fossils have been found to make possible a paleontologic correlation.

Campbell, M. R., U. S. Geol. Survey Geol. Atlas, Masontown-Uniontown folio (No. 82), 1902.

This report covers an area lying largely in the southern part of Fayette County. It gives very briefly the general stratigraphy of the area and some notes on the mineral resources (chiefly coal). Its chief contribution is the set of fine geological maps showing general geology, structure, and economic geology.

Campbell, M. R., U. S. Geol. Survey Geol. Atlas, Brownsville-Connellsville, folio (No. 94), 1903.

This report covers an area which includes the northern part of Fayette County. It gives very briefly the general stratigraphy of the area and some notes on the mineral resources (chiefly coal). Its chief contribution is the set of fine geological maps showing general geology, structure, and economic geology.

Clapp, F. G., Limestones of southwestern Pennsylvania: U. S. Geol. Survey Bull. 249, 1905.

One section of this report deals with limestones in the Monongahela Valley, part of which lies in Fayette County. The Loyalhanna, Greenbrier, Upper Freeport, Pittsburgh, Redstone, Sewickley, Benwood, Waynesburg, Dunkard and Upper Washington limestones are briefly described. A few scattered analyses are given.

d'Invilliers, E. V., Pittsburgh coal region: Pennsylvania 2d Geol. Survey, Annual Rept. 1885, pp. 125-206, 1886.

This report gives lists of elevations in the area, followed by general description of major structural features and general stratigraphic descriptions, most of which apply to areas outside of Fayette County.

d'Invilliers, E. V., Pittsburgh coal region: Pennsylvania 2d Geol. Survey, Annual Rept. 1886, 1887.

Following general and structural descriptions of the district as a whole, more detailed county descriptions are given. Fayette County, pp. 328-370. The descriptions are confined to the Upper Productive and Upper Barren Coal Measures (Monongahela group and Dunkard series) in the district closely adjacent to the Monongahela River.

Fettke, C. R., Glass manufacture and the glass sand industry of Pennsylvania: Pennsylvania Topog. and Geol. Survey Commission, Report XII, 1919.

After a detailed discussion of glass manufacture and raw material requirements and specifications, the glass sand deposits of Pennsylvania are described. Fayette County, pp. 245-247. The Pottsville sandstone in the neighborhood of Dunbar is producing glass sand.

Genth, F. A., The mineralogy of Pennsylvania: Pennsylvania 2d Geol. Survey, vol. B2, p. 212, 1875.

The analysis of a mineral spring water is recorded. The spring, "Fayette Spring," is located in Wharton Township, Fayette County, on the east side of Chestnut Ridge.

Hice, Richard R., Oil and gas map of southwestern Pennsylvania: Pennsylvania Topog. and Geol. Survey Commission, 1916.

Shows proven productive oil and gas acreage. Superseded by later publications.

Hopkins, T. C., Clays of western Pennsylvania: Pennsylvania State College, Ann. Rept. 1897, appendix, 1898.

After a general statement about clay, clay deposits are reported. The parts referring to Fayette County are as follows:

I. *Pottery clay:* The Carmichaels clay is used at Point Marion and New Geneva, pp. 24-28.

II. *Fire clay:* In the Youghiogheny River Valley at Layton Station, Lavenia Station, Connellsville, Stewarton, Ohiopyle, Bailey Point, Mt. Braddock, Lemont Furnace and Emme fire clay has been mined. The clay comes from Brush Creek (?), Mahoning, Upper Freeport, Bolivar and Brookville-Clarion horizons.

III. *Paving and building brick:* Deposits are located at Connellsville, Layton, Dawson, Uniontown and Fairchance. Clay comes from Carmichaels clay, and some of the fire clay beds. Along the Monongahela River at Fayette City shale is used.

Kemp, J. F., and Ross, J. G., A peridotite dike in the coal measures of southwestern Pennsylvania: Ann. New York Acad. Sci., vol. 17, part 2, pp. 509-518, 1907.

After a general description of basic igneous dikes in the Coal Measures of the eastern United States, the dike in the Gates coal mine is described. Commonly thin it splits in places and it is recorded as reaching a maximum thickness of 35 feet at the horizon of the Pittsburgh coal bed. The minerals present are biotite, olivine, magnetite, perofskite and apatite, the first three of which also occur in phenocrysts. Garnet is reported which has kelyphite rims. An analysis of the rock shows much more calcium than is required by the minerals.

Leighton, H., Clay and shale resources of southwestern Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 17, 1932.

After a brief description of the general features of clays follow reports of deposits in various counties. Fayette County, pp. 98-109. The report closes with tables of analyses and physical and burning tests. The following clay beds are described: Brush Creek, Upper Freeport, Bolivar, Lower Kittanning, Brookville, Mercer.

Lesley, J. P., Carboniferous system: Pennsylvania 2d Geol. Survey, Summary Rept., vol. III, 1895.

A general report dealing with the Carboniferous strata of Pennsylvania. The sections which refer to Fayette County are merely summaries of the data given in Reports KK and KKK by J. J. Stevenson.

Martin, G. C., U. S. Geol. Survey Geol. Atlas, Accident-Grantsville folio (No. 160), 1909.

This report deals with an area lying largely outside of Fayette County, and only includes about 10 square miles in the southeast corner of the county. The report consists of brief descriptions of the stratigraphy and economic geology coupled with detailed geological maps of the area.

Miller, B. L., Lead and zinc ores of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 5, p. 47, 1924.

The report deals with lead and zinc throughout Pennsylvania, and on page 47 a brief entry appears noting the presence of galena and sphalerite in small quantities in the Pocono sandstone in Victor Hollow, Georges Township. The same materials have been noted elsewhere in the Pocono sandstone of Fayette County.

Miller, B. L., Limestones of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 7, 1925.

After a general discussion on the character and uses of limestone, specific limestones are discussed by areas. Fayette County, pp. 259-267. This report has been superseded by Bulletin M 20.

Miller, B. L., Limestones of Pennsylvania (second edition): Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 20, 729 pp., 1934.

Part I deals with limestone in general. The subjects dealt with are chemical composition, mineralogy, physical properties, origin, weathering, characteristics of limestone regions, uses, geologic and geographic distribution. Production statistics for Pennsylvania are given.
Part II. Detailed descriptions by counties. Fayette County, pp. 365-376. The principal limestones used in Fayette County are the Loyalhanna and Greenbrier. Many limestone strata in the Coal Measures are quarried locally for farm use.

McCreath, A. S., Chemical analyses, Part II: Pennsylvania 2d Geol. Survey, vol. MM, 1879.

This report lists the results of chemical analyses and gives brief notes on the occurrence of the samples. The following analyses were made for Fayette County material: Carbonate iron ore, 36; Coal, 16; Clay and brick, 4; Zinc and lead ores, 4; Limestone, 3, and Hematite, 1.

Piper, A. M., Ground water in southwestern Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. W 1, 1933.

The first half of the book is given up to data applicable to the whole of southwestern Pennsylvania, and includes sections on climate, surface features, geologic and physiographic history, structural geology, and a detailed discussion of ground water occurrence and accumulation. This is followed by a bed by bed description of the water-bearing properties of each sandstone and limestone. The last half of the book is composed of county reports, giving details of wells and ground water resources. Fayette County, pp. 288-307.

Platt, F., Coke manufacture: Pennsylvania 2d Geol. Survey, vol. L, 1876.

The following parts of the report apply to Fayette County:
1. The Coal Measures of the Youghiogheny.
2. The geological columns at Connellsville.
4. The Connellsville coke trade.
5. On coking the Connellsville coal.
6. The Youghiogheny gas coal trade.
7. On the iron ores and fire clays.

Robinson, J. F., Stratigraphy of southwestern Pennsylvania: Eng. Soc. of Western Penna., 1930.

This report deals with the stratigraphy of the sands encountered in drilling oil and gas wells. It does not deal with surface stratigraphy except in so far as it attempts to give for certain of the sands the equivalent sandstone at the surface. It enumerates 41 sands that produce either oil, gas, or both, in the area. Type sections are given for many townships in southwestern Pennsylvania, 9 of which are located in Fayette County.

Rogers, H. D., The geology of Pennsylvania. 1858.

This very early treatise is the final report on the work of the First Pennsylvania Geological Survey, and deals with the geology of all the State. Certain sections of it deal with the geology of Fayette County. Owing to the fact that the names applied by Rogers to many of the strata of Pennsylvania have been changed and are no longer in use, this report is difficult for anyone who does not know the modern equivalents of the old names.

Sisler, J. D., Bituminous coal losses and mining methods in Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 4, 1924.

This report contains descriptions of coal beds by districts and estimates the losses in mining them. It does not give very complete data and has been superseded by report M 6.

Sisler, J. D., Ashley, G. H., Moyer, F. T., and Hickok 4th, W. O., Contributions to oil and gas geology of western Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 19, 1933.

This report consists of four parts:
I. Stratigraphy of the oil and gas fields, by Ashley and Sisler.
II. Correlation of oil and gas sands, by Sisler.
III. Statistics of petroleum and natural gas, by Moyer.
IV. Analyses of natural gas and petroleum, by Hickok.

Shaw, J. B., Fire clays of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 10, 1928.

This report gives physical tests and chemical analyses of 81 fire clay samples. It contains an appendix by Geo. H. Ashley in which brief descriptions of the fire clay strata of several counties (including Fayette) are given.

Smith, L. B., Peridotite dike in Fayette and Greene counties: Pennsylvania Topog. and Geol. Survey Commission Rept. for 1910-1912, Appendix F, pp. 150-155, 1913.

This paper gives in great detail the location and size of the basic igneous dike in the Gates mine with a very brief description of a microscopic study of its mineralogy.

Stevenson, J. J., The geology of the Fayette-Westmoreland District, Part I. Eastern Allegheny, western Fayette and Westmoreland counties: Pennsylvania 2d Geol. Survey, vol. KK, 1877.

This report covers the part of Fayette County west of Chestnut Ridge. The geology is given in great detail but has not been well organized and the map accompanying the report is very poor. Much of the text refers to places which cannot be located.

Stevenson, J. J., The geology of Fayette and Westmoreland district, Part II, The Ligonier Valley: Pennsylvania 2d Geol Survey, vol. KKK, 1878.

This report covers the eastern half of Fayette County. The geology is given in detail but has not been well organized, following rather a haphazard wandering in each township. The map accompanying the report is very poor and gives few of the locations mentioned in the text.

Stone, R. W., Pennsylvania caves: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. G 3, 1932.

This general report on Pennsylvania caves describes Dulany cave on Chestnut Ridge in Fayette County. The cave was formed by solution of the Loyalhanna limestone and is one of the largest in Pennsylvania.

Stone, R. W., Building stones of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 15, 1932.

After general statements on kinds of stone available, its uses and character. and the geology of Pennsylvania, there follow descriptions of quarries and stone buildings in each county of the State. Fayette County, pp. 156-160.
Waynesburg, Mahoning, Saltsburg, Homewood, and Pocono sandstone, and Loyalhanna limestone are quarried in Fayette County.

Stone, R. W., Molding sands of Pennsylvania: Pennsylvania Topog. and Geol. Survey, 4th ser., Bull. M 11, 1928.

After a short section on the use, classification and testing of molding sand, there follows a brief discussion of its origin and geology. The molding sand deposits of Fayette County are described, pp. 56-58.
Low terrace sand near Connellsville.
Flood plain sand near Connellsville.
Carmichaels sand near Perryopolis.
Connoquenessing sandstone, Dunbar.

Stone, R. W., U. S. Geol. Survey Geologic Atlas, Waynesburg folio (No. 121), 1905.

The Waynesburg quadrangle contains about 2 square miles of Fayette County. The report gives general geological data and an excellent map.

Wall, J. S., Monongahela River coal mines: Pennsylvania 2d Geol. Survey, vol. K4, 1884.

This report deals for the most part with the operation and equipment of coal mines. Sections of the Pittsburgh coal bed are given for some of the mines.

White, I, C., Stratigraphy of the bituminous coal fields of Pennsylvania, West Virginia, and Ohio: U. S. Geol. Survey Bull. 65, 1891.

This report is divided into the following five parts:
1. Dunkard series—does not apply to Fayette County.
2. Monongahela group. Section at Brownsville given.
3. Elk River (Conemaugh) group. Section on Dunbar Creek given.
4. Allegheny group. Section on Cucumber Run given.
5. Pottsville series. No section in Fayette County given.

Willard, B., Chemung of southwest Pennsylvania: Pennsylvania Acad. Sci., vol. 7, pp. 148-159, 1933.

The marine Chemung of southwest Pennsylvania is believed to be of Middle Chemung age. If the overlying beds are actually basal Mississippian, a decided disconformity is present. Devonian sedimentation appears to have closed with the deposition of marine strata rather than non-marine "Catskill" over much of this region.

GEOGRAPHY AND CIVILIZATION

TOPOGRAPHY

The topographic description of Fayette County can be divided into two parts corresponding to the two sections of the Appalachian Plateau Province which are there represented.[1] The eastern half of the county forms parts of the Allegheny Mountain section, a plateau of strong relief where open folding of the rocks and differential erosion have produced linear ridges; the western half lies in the Kanawha section, a mature plateau of fine texture where the outstanding characteristic is a gently rolling upland dissected by many steep-sided stream valleys.

Eastern Fayette County contains two mountain ridges, the valley between them, and in the extreme southeastern corner part of a second valley. The ridges trend N. 30° E. and stand 800 to 1,500 feet above the adjacent lowlands. From east to west these features are Turkeyfoot Valley, Laurel Hill, Greater Ohiopyle Valley, and Chestnut Ridge.

Turkeyfoot Valley lies mostly in Somerset County, but a small part of it lying west of the towns of Confluence and Somerfield is within Fayette County. The valley consists of a broad rolling lowland below which have been cut the submature inner valley of the Youghiogheny River and the gorges along the lower parts of some of the tributary streams.

Laurel Hill is separated into two parts by the gorge of the Youghiogheny River. The southern part of the ridge is well developed only at its northern end, gradually dying out southward so that it is recognized with difficulty at the southern boundary of the county. The northern part, however, is distinct and is a sort of double-crested ridge. The eastern crest is higher and crooked but continuous, the western might be described as a line of high points on spurs.

Greater Ohiopyle Valley is the southward extension of Ligonier Valley into Fayette County. It is divided into three parts by the Youghiogheny River. The northern part extending from Mill Run to the north county line is designated Indian Creek Valley. Indian Creek and its tributaries have entrenched themselves 200 to 300 feet below the gently rolling former valley floor. The central part extending from Mill Run to Ohiopyle is a gently rolling lowland except along Youghiogheny River where down cutting of that stream and its tributaries has produced gorges 300 to 400 feet deep. The southern part, lying between Ohiopyle and Pennsylvania-West Virginia State line, is chiefly a mature valley floor. Only along the northern and southern edges has rejuvenation of the streams enabled them to cut gorges below this valley floor.

Chestnut Ridge lies parallel to and about ten miles west of Laurel Hill. In crossing Fayette County it rises gently southward to an elevation over 2,750 feet near the State line. It is crossed by Youghiogheny River a short distance south of Connellsville. Dunbar Creek also rises east of the ridge and cuts through it, interrupting the continuity of the crest. Both flanks of Chestnut Ridge have been notched by small streams rising near the crest line and flowing down the flanks.

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[1] Fenneman, N. M., Physiographic divisions of the United States: Assoc. of Am. Geographers, Annals, vol. 18, no. 4, pp. 261-353, 1928.

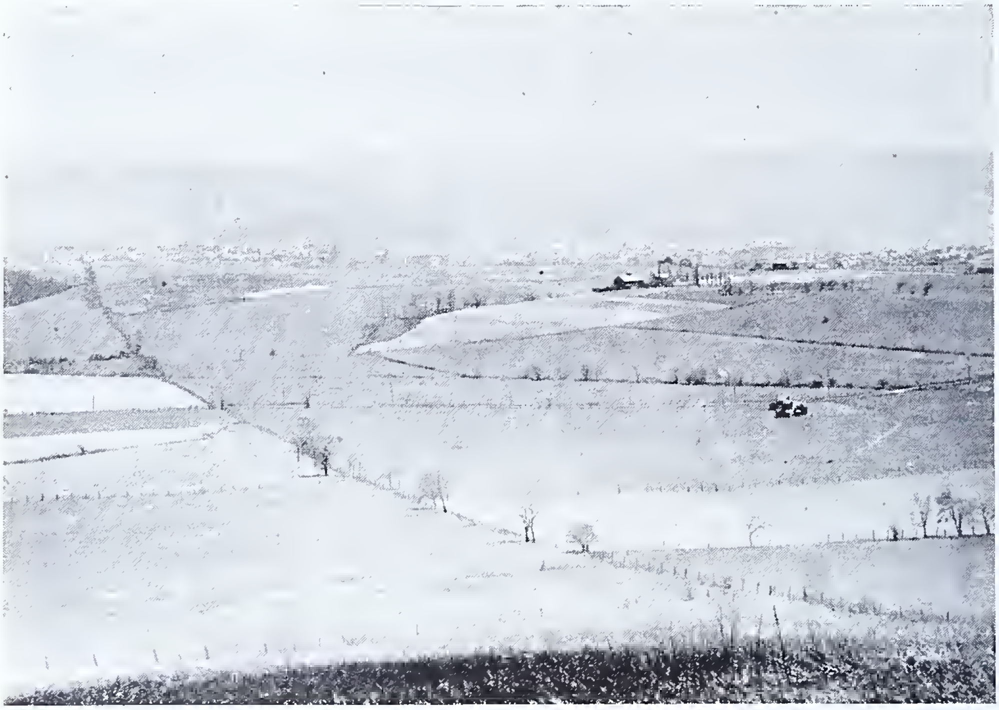

Figure 1. Chestnut Ridge and lowland at Connellsville. View from northeast.

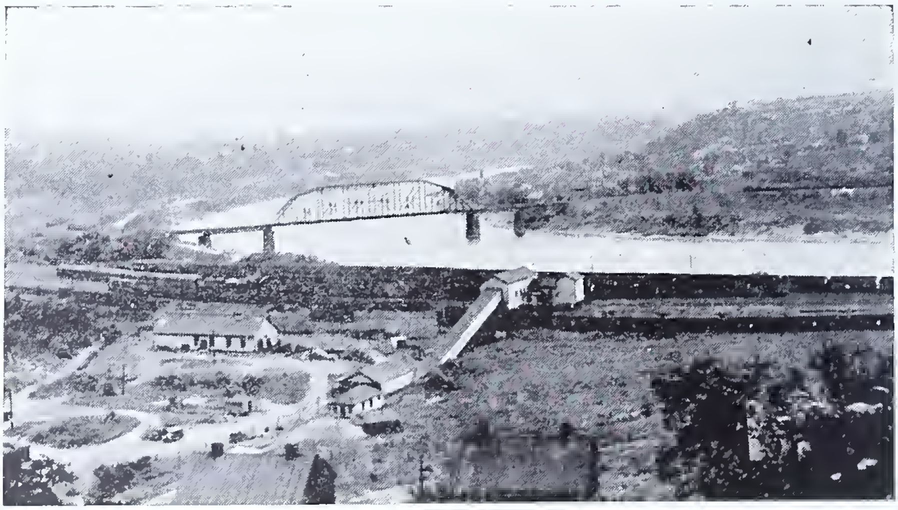

Figure 2. Monongahela River, ½ mile north of Brownsville.

Western Fayette County lies on a mature plateau into which the principal streams and many of their tributaries have entrenched themselves. The upland surface is composed of many well-rounded hills and broad shallow valleys. Its relief is 200 to 300 feet. The steep-sided valleys of the larger streams are cut 400 to 500 feet below the rounded hilltops. In places, erosion has etched the land so deeply that little is left of the former level surface.

The topography divides the county into rather definite districts, each differing from its neighbors in physiography, culture, and industry. The districts are outlined in the accompanying figure.

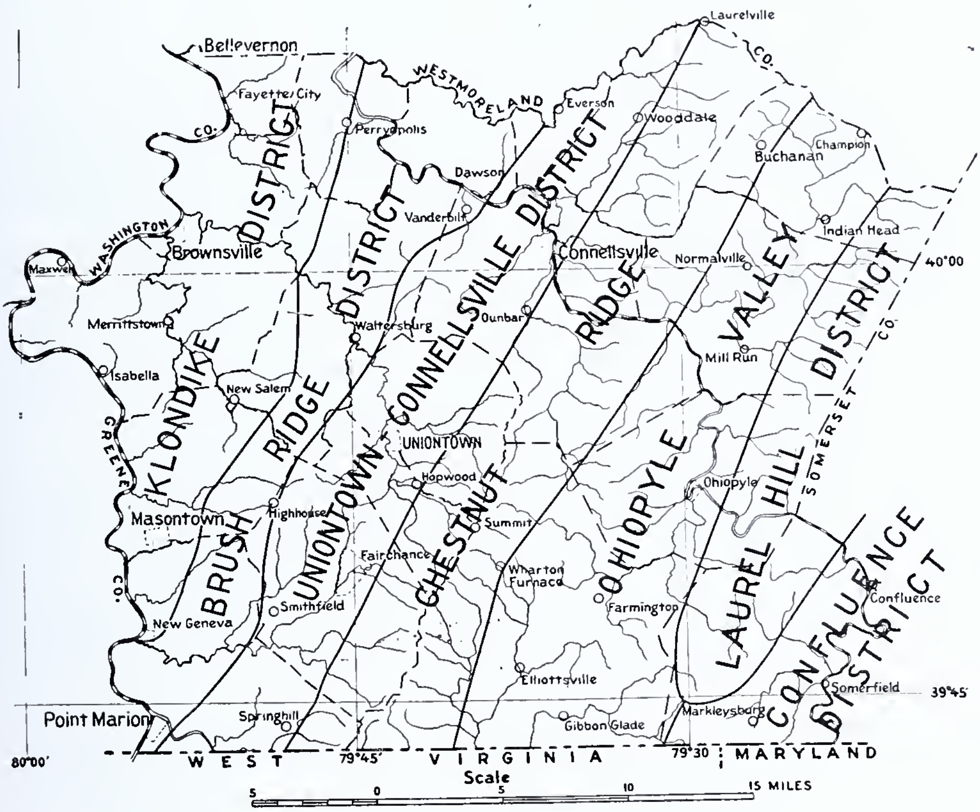

Figure 3. Division of Fayette County into districts.

DRAINAGE

Fayette County lies west of the Appalachian divide and is drained by the Monongahela and Youghiogheny rivers, which are part of the Ohio-Mississippi drainage system. Monongahela River flows north from West Virginia along the western border of Fayette County. At Point Marion it is joined by Cheat River, which itself drains the southwestern part of the county as far east as Chestnut Ridge and by means of Big Sandy Creek the south end of Ohiopyle Valley. The western edge of the county is drained by Georges Creek, Browns Run, Dunlap Creek, Redstone Creek and several small streams, all of which flow westward into Monongahela River.

Youghiogheny River, flowing northward from Maryland in the southeastern corner of the county, winds its way through Laurel Hill and Chestnut Ridge in a northwestward direction to leave the county a few miles north of Perryopolis. This river unites with the Monongahela several miles north of Fayette County. It drains the eastern and northern parts of the county by means of Meadow Run, Indian Creek, Dunbar Creek, Mounts Creek, Jacobs Creek and a great many small streams.

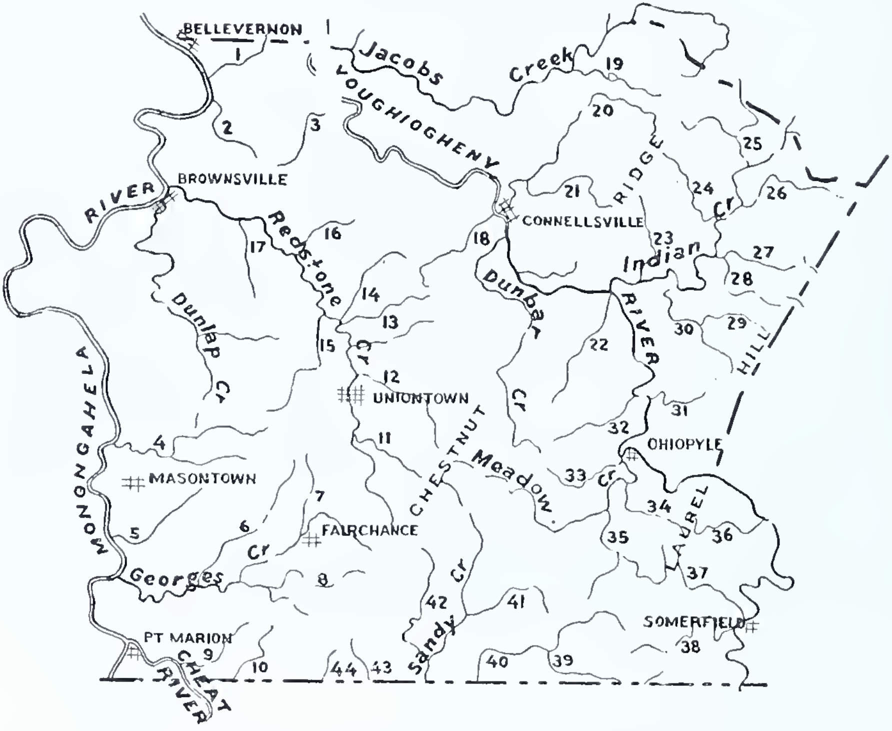

Figure 4. Drainage map of Fayette County.

1. Downers Run
2. Redstone Creek
3. Washington Run
4. Browns Run
5. Jacobs Run
6. York Run
7. Muddy Run
8. Mountain Creek
9. Grassy Run
10. Rubles Run
11. Lick Run
12. Shutes Run
13. Rankin Run
14. Bute Run
15. Jennings Run
16. Bolden Run
17. Row Run
18. Opossum Creek
19. Green Lick Run
20. Mounts Creek
21. Breakneck Run
22. Laurel Run
23. Rassler Run
24. Poplar Run
25. Champion Run
26. Back Creek
27. Laurel Run
28. Buck Run
29. Clay Run
30. Mill Run
31. Bear Run
32. Jonathan Run
33. Cucumber Run
34. Laurel Creek
35. Beaver Creek
36. Ramcat Run
37. Tub Run
38. Hall Run
39. Feik Run
40. Little Sandy Creek
41. Stony Run
42. Quebec Run
43. Laurel Run
44. Patterson Run

CLIMATE

Rainfall. The average annual precipitation in western Pennsylvania ranges from thirty-four to fifty inches. In general, the amount of rainfall is closely related to the topography, the broad lowlands of the Kanawha plateau receiving less rain than the highlands of the Allegheny Mountain plateau. This relationship, however, does not apply in detail especially to a single year's precipitation.

Fayette County, lying partly in the lowlands and partly in the mountainous highlands, has a wide range in rainfall. Precipitation increases generally from west to east, being least along Monongahela River and greatest on Laurel Hill. Normal precipitation varies somewhat from month to month. Minimum rainfall is centered about two periods, one in November the other in February. Maximum rainfall comes in late spring and early summer.

Normal monthly and annual rainfall at stations in and near Fayette County, in inches.

	Years of record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Confluence, Somerset County	19+	3.97	3.39	3.79	3.57	3.97	4.58	4.67	4.01	3.11	2.98	2.98	3.49	44.51
Greensboro, Greene County	38	3.52	2.94	3.50	3.15	3.75	4.62	4.57	3.65	3.04	2.87	2.76	3.05	41.42
Newell, Fayette County	13	2.87	2.27	3.11	2.98	2.76	4.05	3.77	3.06	2.65	2.54	2.28	2.62	34.96
Somerset, Somerset County	51	4.56	3.94	4.27	4.71	4.91	5.20	4.55	4.60	3.64	3.10	3.43	3.90	50.81
Uniontown, Fayette County	45	3.72	3.08	3.88	3.74	3.96	4.77	4.83	4.62	3.26	3.32	3.16	3.37	45.77
West Newton, Westmoreland County	20+	3.31	2.97	3.48	3.28	3.61	4.08	4.12	3.77	2.73	2.72	2.47	3.21	39.75

The annual precipitation at Uniontown ranged between 31.94 and 70.68 inches for the period 1888 to 1933. The mean is 45.81 inches, which is slightly above the average figure of 42.38 inches for the State of Pennsylvania as a whole. Thus rainfall in the western part of the county is equal to, and in the eastern part much greater than, the average of the State. The longest period of more than normal rainfall is the seven years from 1896 to 1902, in which the average yearly rainfall is 49.14 inches. The longest period of less than normal rainfall is the six years period from 1928 to 1933, in which the average yearly rainfall is 41.01 inches. The accompanying table gives the annual precipitation figures for all weather stations in and around Fayette County.

Annual precipitation in inches in Fayette County and surrounding areas.

Year	Uniontown, Fayette Co.	Somerset, Somerset Co.	Greensboro, Greene Co.	Confluence, Somerset Co.	West Newton, Westmoreland Co.	Newell, Fayette Co.	Kregar, Westmoreland Co.	Lake Lynn, Fayette Co.
1888......	52.10	47.80						
1889......	54.56	51.34	46.68					
1890......	70.68	66.26	65.15					
1891......	51.12	50.13	49.14					
1892......	44.68	41.25	36.17					
1893......	38.99	45.00	33.76					
1894......	41.43	57.15	35.74					
1895......	38.65	31.48	34.64					
1896......	49.44	52.61	46.71					
1897......	45.08	47.80	40.47					
1898......	50.72	55.19	48.63					
1899......	50.74	51.13	49.90					
1900......	47.34	55.68	44.53					
1901......	52.78	55.44	44.34					
1902......	47.86	56.39	41.81					
1903......	38.05	45.20	42.19					
1904......	31.94	50.44	34.14					
1905......	46.21	59.38	45.49					
1906......	42.65	56.70	36.64					
1907......	54.60	64.05	50.89					
1908......	38.75	49.87	36.54					
1909......	43.04	41.76	34.56					
1910......	39.50	47.04	36.32					
1911......	54.51	63.99	44.63					
1912......	48.68	60.95	46.71					
1913......	54.92	49.67	47.23					
1914......	40.76	54.33	35.66	35.62	36.95			
1915......	.....	59.61	40.05	40.67	41.74			
1916......	46.78	55.73	41.88	49.92	45.10			
1917......	37.34	55.20	39.45	37.72	37.14			
1918......	41.16	53.99	41.00	47.69	44.52			
1919......	52.05	57.05	44.15	47.73	47.54			
1920......	47.20	57.70	36.80	.....	39.81	29.53		
1921......	55.44	62.91	.....	50.13	44.85	40.14		
1922......	35.56	42.94	.....	31.88	34.31	28.76		
1923......	42.30	51.85	.....	44.68	35.87	33.39		
1924......	42.74	55.80	.....	46.16	36.08	.....		
1925......	40.17	.....	.....	40.95	34.67	34.27		
1926......	45.91	.....	.....	45.01	39.22	33.15	46.98	
1927......	50.38	51.67	.....	51.65	45.03	39.45	62.86	
1928......	40.82	42.72	38.04	44.07	36.34	32.21	47.15	
1929......	45.86	.....	46.45	51.85	42.48	33.13	.....	
1930......	31.95	27.30	26.35	29.78	24.64	21.56	34.95	
1931......	43.24	41.87	48.07	44.81	34.73	37.07	51.03	47.06
1932......	38.40	34.19	34.12	44.37	28.92	27.98	37.57	35.41
1933......	45.79	46.59	45.15	51.33	35.77	38.67	52.56	48.02
Average .	45.81	50.81	41.42	44.51	39.75	34.96		

Temperature. The mean annual temperature is 52.6° Fahr. at Uniontown, 52.9 at Newell, and 47.6 at Somerset.

Mean monthly temperatures in °F. at stations in and near Fayette County.

Station	Years of record	Altitude	Jan.	Feb.	Mar.	Apr.	May
Uniontown	44	1,100	32.3	32.4	41.5	51.2	61.8
Newell	13	800	32.1	32.6	43.0	51.4	61.4
Somerset	66	2,190	26.4	27.0	36.0	46.4	56.8

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Uniontown	69.9	73.1	71.6	64.6	54.6	43.6	34.8
Newell	69.3	73.3	71.5	67.2	55.5	43.6	34.9
Somerset	65.4	68.7	67.2	60.9	49.4	38.8	28.6

The table given above shows January to be the coldest month and February only slightly less cold. July is the warmest month and August next. The altitude of Somerset causes the temperature to average five degrees lower there. The average temperature for the

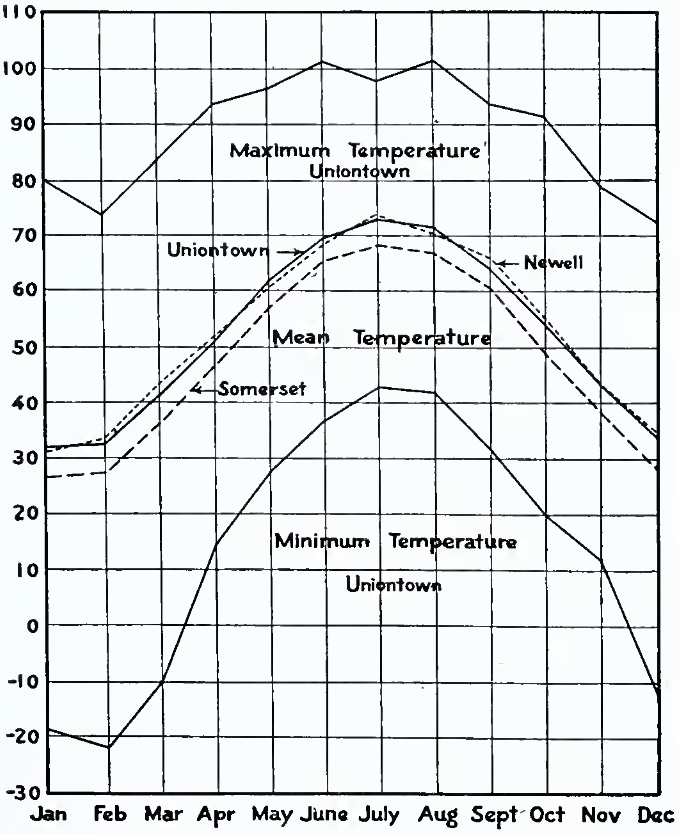

Figure 5. Graph of temperature in degrees Fahrenheit by months.

State is 50° F. The lowlands about Uniontown and Newell are warmer than the State as a whole, whereas the mountainous eastern part of Fayette County, as shown by the records taken at Somerset, is cooler.

Snowfall at Somerset, which may be taken as representing the eastern highlands of Fayette County, was 63 inches in 1933, whereas at Uniontown in the western lowlands it was only 21 inches that year. These figures are representative of most years. At Somerset likewise the frost-free period is much shorter than at Uniontown. Somerset has an average frost-free period of 134 days with the shortest and longest known periods 86 and 171 days respectively. Uniontown, on the other hand, has an average frost-free period of 174 days and the shortest and longest recorded periods are 141 and 212 days respectively.

VEGETATION

Agriculture. Agricultural products are produced in large amounts in Fayette County even though the county is not classified as an agricultural county because of the great mineral wealth it contains and because the population is too large to be fed by home-grown products.

Census figures for 1910, 1920 and 1930 show the population of the county to be increasing, the number of farms decreasing slightly, and the acres of land in cultivation to have decreased 22 per cent. It seems probable that the reason for the large decrease in cultivated land as opposed to the small decrease in number of farms lies in a tendency for many farmers to spend part of their time working in coal mines and for some coal miners to do farming when mining is slack.

	1910	1920	1930
Population	167,449	188,104	198,542
Number of farms	3,818	3,267	3,364
Land in farms	318,475	281,984	247,806

Two soil types predominate in Fayette County. The Westmoreland type, which is a good agricultural soil, occupies the land west of Chestnut Ridge and the northern part of Indian Creek Valley. Chestnut Ridge and Laurel Hill, and the southern part of Greater Ohiopyle Valley are covered with DeKalb soils which are too coarse to be well suited to agriculture.

Two types of farms predominate in Fayette County. Part-time farming, a subgroup of the abnormal farm class, predominates west of Chestnut Ridge in the region of intensive coal mining. The second most important type in the region is general farming, with its variety of products, and the third is dairy farming. In the area on and east of Chestnut Ridge general farming is the predominant type, whereas abnormal and self-sufficing farming are of secondary importance.

Milk is the most valuable farm product in Fayette County.

Value of crops and livestock products produced on farms in Fayette County in 1936 follow:

Corn	$611,450	Apples	$36,750
Winter wheat	183,190	Pears	4,860
Oats	141,690	Grapes	3,250
Barley	2,610	Milk	1,380,970
Rye	5,580	Eggs	321,880
Buckwheat	21,730	Wool	7,730
Potatoes	266,130	Honey	11,210
Tame hay	586,870		

The table below gives the annual quantities of agricultural goods produced and the livestock on farms in Fayette County in certain years:

FAYETTE COUNTY FARMS.

Livestock, livestock products, crop acreage and production.

(Source: U. S. Censuses, except as noted.)

	Apr. 15, 1910	Jan. 1, 1920	Apr. 1, 1930	Jan. 1, 1935
LIVESTOCK NUMBERS				
Horses and mules	8,648	7,662	5,112	4,835
Cows	9,909[1]	9,009[2]	8,509[3]	12,193[2]
Other cattle	9,950	7,234	10,066	7,944
Swine	15,562	14,048	9,499	8,304
Sheep	10,448	6,218	8,018	4,621
Chickens	149,035	170,104	188,141[4]	190,314[4]
Hives of bees	1,696	1,568	2,530[5]	2,250[6]
LIVESTOCK PRODUCTS	1909	1919	1929	1934
Milk (gallons)	3,479,697	2,758,293	4,698,839	4,866,944
Eggs (dozens)	868,962	840,744	1,405,375	1,076,179
Honey (pounds)	22,401	13,793	24,060[5]	48,250[6]
ACREAGE IN PRINCIPAL CROPS				
Corn	22,736	18,563	14,150	17,237
Wheat	13,248	13,573	6,373	8,548
Oats	15,130	16,301	12,432	12,666
Potatoes	2,113	1,279	1,457	1,762
Hay	39,209	37,010	36,986	34,552
PRODUCTION OF PRINCIPAL CROPS				
Corn for grain ... bus.	717,620	850,775	440,048	543,475
Wheat threshed ... bus.	186,944	211,676	112,342	122,610
Oats threshed ... bus.	371,325	472,788	358,937	293,443
Potatoes ... bus.	163,964	98,148	169,898	184,191
Hay ... tons	41,338	41,643	45,025	36,182
Apples ... bus.	72,548	32,991	23,398	20,045
Peaches ... bus.	34,369	19,817	9,659	998
Pears ... bus.	2,202	1,021	3,305	9,613

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[1] Dairy cows.
[2] Cows and heifers 2 years old and over.
[3] Cows and heifers born before 1928.
[4] Over 3 months of age.
[5] On farms and elsewhere.
[6] Estimated.

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Only a very small quantity of prepared fertilizer was used in 1933 in Fayette County and that on only 51 percent of the farms. On the other hand, Fayette stands second among the counties of Pennsylvania in the use of agricultural lime. The reason for the large use of lime rather than prepared fertilizer is thought to lie in the occurrence of limestone on many farms along with the coal necessary for burning it into agricultural lime. (For further data on lime see the section on limestone in Part II of this report.)

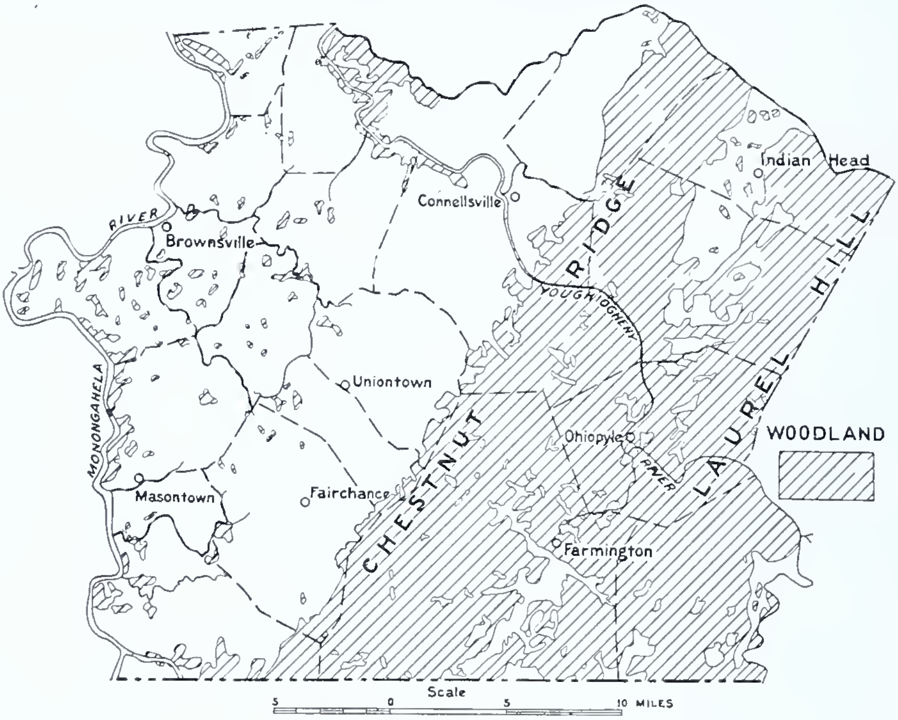

Figure 6. Map showing woodland areas in Fayette County.

Woodlands. The forest area of Fayette County is largely confined to the eastern half. (See Fig. 6.) The area lying west of Chestnut Ridge is 10 percent woodland, whereas that on and east of the ridge is 80 percent woodland. Hardwoods such as oak, hickory, ash, poplar, gum, and maple predominate over other species. The woods in the western part of the county are for the most part on the slopes too steep to be cultivated. In the eastern part of the county, on the other hand, woods cover a great part of the flat lands as well as the steep slopes. The non-wooded areas are confined to the Greater Ohiopyle Valley and the lowlands along Youghiogheny River near Somerfield and Confluence, where the soil is suitable for agriculture.

A great part of the woodland has been cut over repeatedly to obtain timber for use in the coal mines of the county. The mine timbers are sawed by portable mills which are moved from tract to tract as the cutting progresses. The timber is hauled to the mines by truck.

There is very little State-owned forest land in Fayette County. In the northeastern corner a small part of a State forest largely in Somerset County lies along the top of Laurel Hill. Fort Necessity State Park, which contains some woodland, lies two miles west of Farmington along the National Pike. The State Game Commission owns an area on Chestnut Ridge east of Dunbar and Mt. Braddock that contains two game refuges and considerable woodland.

TRANSPORTATION

Three types of transportation are used in Fayette County: water, railroad and highway. Barges on Monongahela River carry great quantities of coal and other heavy material. A large part of the coal mined in the county is moved in this manner. Railroads are confined largely to the western half of the county and penetrate east of Chestnut Ridge only along the Youghiogheny River and Indian Creek. Paved highways reach nearly all parts of the county, but are especially abundant in the thickly settled western lowlands.

Water transportation. Monongahela River has been made navigable by a series of dams and locks from Pittsburgh south to Fairmont, West Virginia. This affords a cheap means of moving coal from the Fayette County mines to the important Pittsburgh industrial district. Mines several miles from the Monongahela haul coal underground to the river bank and load it directly into barges for transport to Pittsburgh. The following table gives the volume of goods transported on Monongahela River. Only about one-quarter of the total, however, is ascribable to Fayette County.

Freight carried on Monongahela River in 1930 in tons

Classification	Inbound	Out-bound	Upbound	Down-bound	Total
Coal	43,410	5,824,139	21,090	14,832,926	20,721,565
Coke	10,970	764,093	56,075	310,208	1,141,346
Sand and gravel	1,689,765		187,500	28,163	1,905,428
Ores, metals, etc.	413,511	772,211	155,827	146,743	1,488,292
Chemicals		29,024	3,801	172,992	205,817
Miscellaneous	118,964	56,374	5,767	13,501	194,606
Total	2,276,620	7,445,841	430,060	15,504,533	25,657,054

Railroad transportation in Fayette County is well distributed between four main companies. (See Fig. 7.) The Pennsylvania Railroad Co. with its subsidiary, the Monongahela Railway, operates the greatest mileage of track in Fayette County. One line runs south from Greensburg, Westmoreland County, through Everson, Connellsville, Uniontown to Fairchance. Another follows Redstone Creek from Uniontown to Brownsville; a third follows Monongahela River south from Brownsville; a fourth runs up Dunlap Creek from Brownsville to join a fifth which connects Uniontown and Huron on Monongahela River.

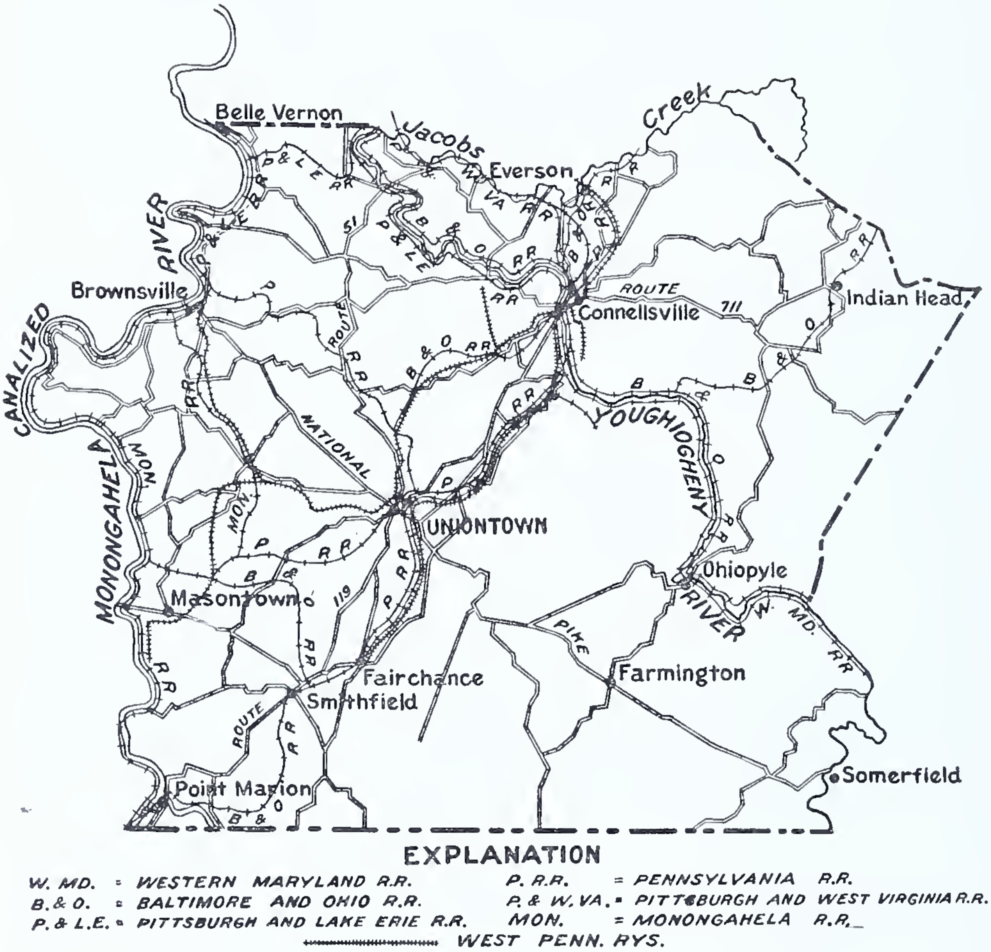

Figure 7. Map showing railroads and principal highways.

The main line of the Baltimore & Ohio Railroad follows Youghiogheny River across the county. One branch line runs south from Confluence, Somerset County, along the west bank of Youghiogheny River through Somerfield into Maryland. A second branch line follows Indian Creek through Normalville and Indian Head to Kregar, Westmoreland County; a third runs south from Connellsville through Uniontown, Fairchance, Smithfield and Point Marion into West Virginia; a fourth runs north from Connellsville through Everson to Mount Pleasant, Westmoreland County; a fifth connects Smithfield and Leckrone.

The Western Maryland Railroad enters the county at Confluence and follows down Youghiogheny River to Connellsville, where it has a terminal junction with the Pittsburgh & Lake Erie Railroad, which has one line up Youghiogheny River to Connellsville and another up the Monongahela to Brownsville. The Pittsburgh & West Virginia Railroad has a freight line from Connellsville north to Clairton, Allegheny County.

The West Penn Railways Company operates fast trolleys and a small freight and express service throughout most of the western part of the county. Its lines connect Everson, Connellsville, Uniontown, Brownsville and Masontown. The Dunbar Corporation operates a few miles of railroad along Dunbar Creek connecting several plants there with the four main railroads of the county at Connellsville.

Highway transportation. Many miles of improved highways in Fayette County have opened up all the county except parts of the higher unsettled mountains. The National Pike, U. S. Route 40, crosses the county in a northwest direction, entering at Somerfield and passing through Farmington and Uniontown to leave at Brownsville. U. S. Route 119 crosses the county from north to south; it enters at Everson and passing through Connellsville, Uniontown, and Smithfield, it leaves at Point Marion. State Route 51 starting at Uniontown runs north through Waltersburg and Perryopolis to leave the county at Wickhaven. State Route 711 enters the county at Champion on Indian Creek and passing through Indian Head, Normalville, Connellsville, Vanderbilt and Fayette City, it leaves the county at Belle Vernon. State Route 381 starting at Normalville follows the Ohiopyle Valley south through Mill Run and Ohiopyle to Farmington. State Route 21 starts at Uniontown and, running west through New Salem, crosses the western boundary of the county at Jacobs Ferry. Many of the connecting roads are paved; they are shown on the transportation map, Figure 7.

OUTLINE OF GEOLOGY OF SOUTHWESTERN PENNSYLVANIA

The rocks of southwestern Pennsylvania are almost entirely sedimentary and were deposited for the most part in the Mississippian, Pennsylvanian and Permian periods. At a few places where streams have breached anticlines, Devonian strata are exposed. Since deposition, the rocks have suffered folding in the Appalachian Revolution. A very minor amount of faulting has been observed in a few places.

ALLEGHENY MOUNTAIN SECTION

The Allegheny Mountain province in southwest Pennsylvania lies between the Allegheny Front and the west flank of Chestnut Ridge. It consists of prominent anticlinal ridges and the intervening synclinal valleys. The strata making up the terrain are Devonian, Mississipian and Pennsylvanian in age. The older rocks are exposed along the anticlinal ridges and consist predominantly of the Pottsville, Mauch Chunk, Pocono and Upper Devonian strata. The valleys on the other hand are floored with Allegheny, Conemaugh and in a very few places Monongahela strata. The preservation of the younger strata only in the valleys and their complete removal from the ridges indicates the amplitude of the folding which in places is 3,000 to 4,000 feet.

The three major anticlines in the section extend northeast to southwest and are parallel with the Allegheny Front. They are Negro Mountain on the east, Laurel Hill in the center, and Chestnut Ridge on the west. Each of the anticlinal ridges is capped in most places by the Pottsville conglomerate, whereas elsewhere the Pottsville rides high up the flanks of the ridges and the summits are formed by Pocono sandstone. The valleys on the other hand are commonly floored with the Conemaugh group of sediments through which the local drainage has cut steep-sided gorges to expose the Allegheny group. The Monongahela group is preserved only in hilltops at two places in these valleys, one north of Ligonier, and the other at Meyersdale.

KANAWHA SECTION

The broad Kanawha Plateau occupies all of southwestern Pennsylvania west of Chestnut Ridge. In this area the folding is moderate and the surface irregularities are determined by the drainage lines rather than by the rock structure. The surface of the plateau is underlain by the Pennsylvanian and Permian strata and no Mississippian comes to the surface. The highest Permian strata are located in the southwest corner of the State and the underlying strata emerge from under them to the east, northeast and north. The Greene group (uppermost of the Permian) is found only in Greene, Washington and Fayette counties. The Washington group (lower part of the Permian) occupies most of the surface of Greene and Washington counties not occupied by the Greene group and extends as outliers on the hilltops of the synclinal troughs through most of the Kanawha region south of Pittsburgh. The Monongahela and Conemaugh groups are abundantly exposed, except in Greene and Washington counties. The Allegheny group and the Pottsville series are exposed only where large streams have cut deep gorges in the Fayette anticline.

STRUCTURE IN FAYETTE COUNTY

FOLDING

General description. Fayette County lies in the Appalachian Plateau where the rocks have been pressed into open folds. Two subdivisions of the Plateau Province are represented in the county. In the eastern part the great open folds of the Allegheny Mountain section have an amplitude of as much as 3,000 feet, whereas in the western part the folds of the Kanawha plateau are of smaller magnitude. The general trend of the folding is in a northeast-southwest direction, but individual folds may vary greatly. Figure 8 shows the position of the anticlinal and synclinal axes in and near the county. The plunge of an axis is shown by arrowheads placed on the axial lines and the steepness is indicated by the number of arrowheads used. The cross section at the lower edge of the figure shows the relative magnitude of the folds. On the geological maps in the pocket more detail is shown. The geological and structural map, drawn to the scale of approximately 1 mile to the inch, shows the anticlinal and synclinal axes in great detail, and the attitude of the rocks is shown by 100-foot structure contours on the top of the Loyalhanna limestone. The structure in the coal basins is shown in more detail on the economic geology map. Twenty-foot contours on the base of the Pittsburgh coal show the structure west of Chestnut Ridge and 50-foot contours on the top of the Upper Freeport coal show the structure east of Chestnut Ridge.

In Fayette County there are four major anticlines, five major synclines and several small anticlines and synclines which are merely minor irregularities of the major features. Starting at the eastern edge of the county, the major features may be enumerated as follows: Johnstown syncline, Laurel Hill anticline, Ligonier syncline, Chestnut Ridge anticline, Uniontown syncline, Fayette anticline, Lambert syncline, Brownsville anticline and Port Royal syncline.

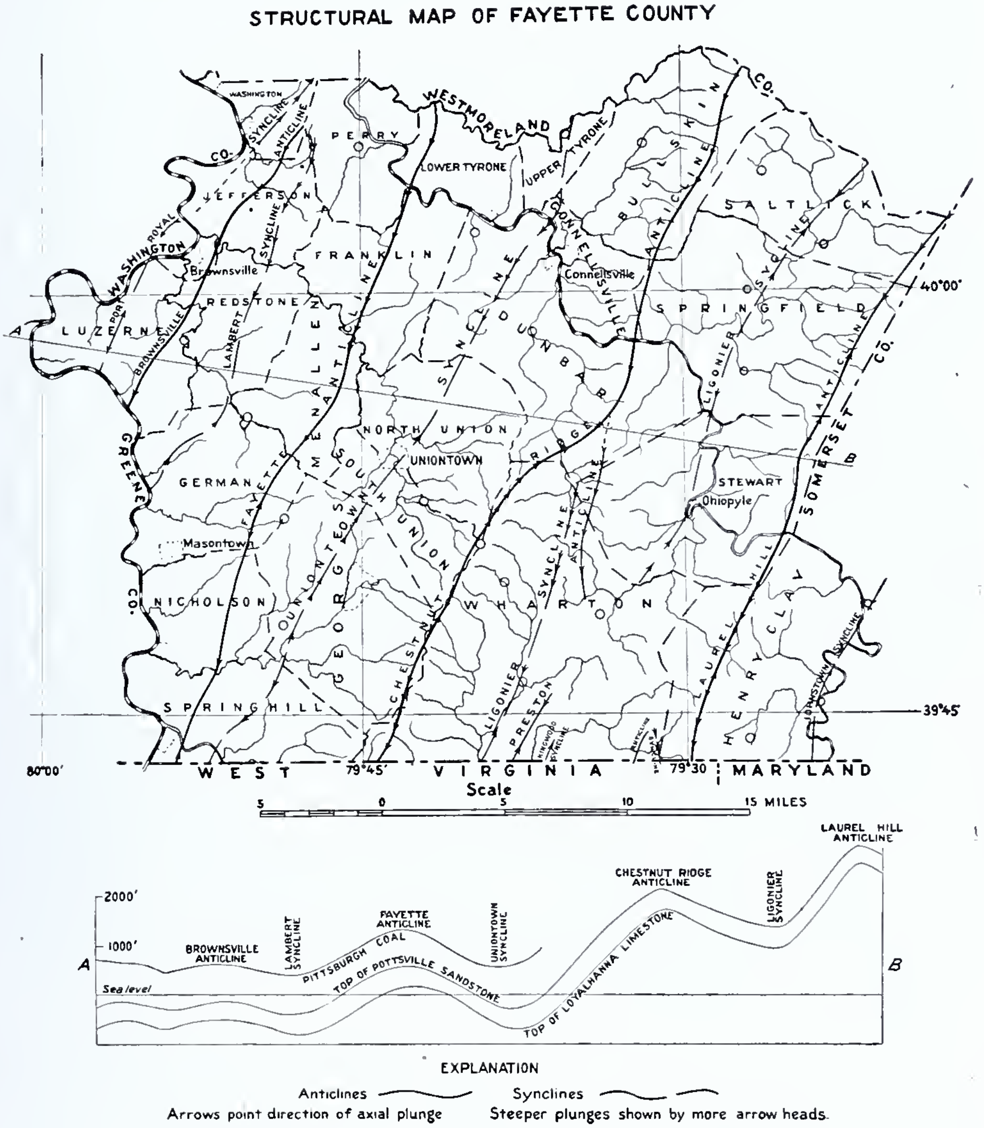

Figure 8. Geologic structure map of Fayette County.

Johnstown syncline. The Johnstown syncline crosses the extreme southeastern corner of Fayette County. The synclinal axis enters the county just south of Confluence and, passing through Somerfield, trends southward into Maryland where it is called the Lower Youghiogheny syncline (Martin 1909).* Youghiogheny River in its meandering course from the Maryland-Pennsylvania line to Confluence repeatedly crosses this axis. Since the river marks the Fayette-Somerset boundary line in this region the axis is in Fayette County only part of the distance from Confluence to the Maryland line. The axis lies nearly level, rising southward less than 100 feet in the seven miles south of Confluence.

Laurel Hill anticline. The Laurel Hill anticline enters Fayette County at its northeast corner. It trends southwest following Laurel Hill and lies within a mile or so of the eastern boundary as far south as Youghiogheny River, a distance of 14 miles. South of the river the axis passes east of the Sugarloaf Knob and through Beaver Creek School and Woodcock Hill. At the latter point it turns straight south, passing into West Virginia about one mile west of the Maryland-West Virginia State line. In West Virginia this anticline is called the Briery Mountain anticline.[2] The axis reaches its greatest height where the anticline crosses the Fayette-Westmoreland boundary. Southward it declines 250 feet in five miles to a low where the axis crosses Middle Fork Creek. It rises 150 feet in the next five miles to a high one mile north of Maple Summit School. In the next six miles to the southwest the strata along the axis are nearly horizontal, declining only 80 feet, but in the following three miles the axis plunges steeply more than 500 feet to a low at Beaver Creek. One mile farther southwest at Woodcock Hill there is a high point only 50 feet above the Beaver Creek low. From here south the anticline plunges 400 feet to the State line, a distance of four miles.

The anticline is marked throughout its length by the broad flat top which in places may be over two miles wide, before the strata descend on the flanks more than 50 feet below their crest along the axis. The eastern flank of the anticline north of Youghiogheny River lies largely in Somerset County, but in the area south of the Youghiogheny it lies in Fayette County. In the latter area the strata dip eastward in a fairly regular manner, and have a maximum inclination of about 700 feet to a mile, and a minimum of 300 feet. The amplitude of the folding between the Laurel Hill anticline and the Johnstown syncline ranges from 700 feet on the Pennsylvania-Maryland boundary to 1,800 along Youghiogheny River.

The western flank of the anticline north of the Youghiogheny is very regular in outline; it has a maximum dip of over 900 feet to the mile and an average of about 500 feet. The amplitude of folding between this part of the anticline and the adjacent Ligonier syncline ranges from 1,500 to 1,800 feet. South of the Youghiogheny the western flank of the anticline becomes much more gentle and near the southern boundary of the county a steeply southward-plunging trough appears about one-third of the way down this flank. The steepest part of this flank is on Sugarloaf Knob, where a maximum dip of 1,000 feet to the mile is recorded, whereas along the National Pike the maximum is 300 feet to the mile. The amplitude of folding likewise is much less south of the river, being 1,600 feet at Sugar Loaf, 850 at the National Pike and 600 along the State boundary line.

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* Names and dates in parentheses indicate references to publications listed in the bibliography.

[2] Hennen, R. V., and Reger, D. B. (Geology of) Preston County: West Va. Geol. Surv., 1914.

A subsidiary wrinkle appears in the western flank of Laurel Hill anticline about three miles north of Five Forks. It consists of a shallow syncline on the east and a low anticline on the west. Rising at Little Sandy Creek, both head south, one passing on each side of Five Forks into West Virginia, where their trend is southwest for five miles before they die out. Both the anticline and syncline plunge steeply to the south and the amplitude of the fold is in all places less than 200 feet. The folds have not been named in West Virginia, and because of their small extent and size are given no names in this report.

Ligonier syncline. Ligonier syncline extends in a northeast-southwest direction and lies about 4 to 6 miles west of Laurel Hill anticline. It enters Fayette County from Westmoreland County at Roaring Run and extends southwest through Sagamore, Whites Bridge, Mill Run Junction, Stewarton, and Ohiopyle. It is offset near Farmington and continues southwest into West Virginia.

The axis of the Ligonier syncline rises southwestward for a short distance after it enters Fayette County at Roaring Run and reaches a high point 2½ miles from the boundary line, after which it declines gently 150 feet in nine miles to a low one mile north of Stewarton. Beyond this low it turns and rises about 40 feet in the next five miles. Just south of Ohiopyle the axis turns southwest again and the strata rise 290 feet in the five miles to Farmington. South of Farmington the axial lines of the Ligonier syncline and the Preston anticline lie within half a mile of each other and the displacement between them is less than 40 feet for a distance of three miles and remains less than 100 feet to the Pennsylvania-West Virginia boundary line.

The Preston anticline of West Virginia enters Pennsylvania between Big and Little Sandy creeks, and may be projected northward to Farmington to join the spur of the Chestnut Ridge anticline. This anticline in Pennsylvania nowhere reaches any great size. South of Farmington the amplitude on either side is less than 100 feet, and the maximum amplitude of the fold occurs on the west flank near Fort Necessity, where it is less than 200 feet. North of Fort Necessity the axis rises steeply up the side of the great Chestnut Ridge anticline, showing almost no closure at all, and joins the axis of the latter anticline just northeast of Paul Flats.

The southern part of the Ligonier syncline crosses the boundary near where Big Sandy Creek crosses and heads northeast to Elliottsville, where it assumes a more northerly trend past General Braddock's grave to die out at a low point in the Chestnut Ridge anticline near Paul Flats. This synclinal axis plunges very gently northeastward from the State line to a low two miles north of Elliottsville. North of the low the syncline becomes merely a shallow trough rising northward diagonally up the side of Chestnut Ridge anticline at a steep gradient.

Chestnut Ridge anticline. The Chestnut Ridge anticline follows a general northeast-southwest trend across Fayette County and lies about 10 miles west of the Laurel Hill anticline. Unlike the Laurel Hill anticline, where the strata have been uplifted more on the north than on the south, the strata along Chestnut Ridge anticline have been raised higher in the southern part of Fayette County than in the north.

The anticlinal axis enters Fayette from Westmoreland County 2½ miles southeast of Laurelton and trending southwest follows near the crest of Chestnut Ridge to pass into West Virginia south of Wymps Gap. A minor high with a closure along the axis of less than 30 feet occurs one mile south of the Fayette-Westmoreland boundary line. A minor low point occurs two miles farther southwest, beyond which the axis rises 200 feet in three miles to a 7-mile-long high which extends southwest for three miles to the Springfield Pike and then south for four miles, crossing the gorge of Youghiogheny River. South of the river the axis again turns southwest and drops 300 feet in two miles to a low at Paul Flats, after which it rises 1,100 feet in six miles to the north end of a high that extends for three miles southwest from Summit. Two miles southwest of this high another smaller one occurs and the intervening low carries the strata down less than 100 feet. South of the second high the axis trends southwest and the strata drop 600 feet to the Pennsylvania-West Virginia boundary in a distance of five miles.

The eastern flank of Chestnut Ridge anticline north of Youghiogheny River has a comparatively gentle dip which averages 300 feet to the mile in the north and central sections, but steepens to 500 feet near the river. South of the river occurs the irregular structure where the northern ends of the Preston anticline and the Elliottsville syncline head up the flank of the Chestnut Ridge anticline. In the vicinity of Summit and southward the eastern flank steepens, having an average slope of 800 feet to the mile. The western flank of the syncline is steeper by far than the eastern. The dip of the strata averages 700 feet to the mile from the Fayette-Westmoreland boundary to the Youghiogheny River. The dip reaches a maximum of 1,800 feet to the mile east of Uniontown, and is 1,200 feet to the mile in the Wymps Gap region.

The folding along the Chestnut Ridge anticline has raised individual strata high above their position in the adjacent synclines, being much greater on the west flank than on the east.

The amplitude of folding on the east and west flanks follows:

	West, feet	East, feet
North boundary	2,000	800
Youghiogheny River	2,400	1,400
National pike	3,400	1,700
State line	2,200	1,200

Uniontown syncline. The Uniontown syncline trends northeast-southwest and lies roughly parallel with Chestnut Ridge anticline and about five miles west of it. The axis crosses the Westmoreland-Fayette boundary one mile east of Scottdale near McClure and trending southwestward passes west of Connellsville, through Monarch, Uniontown, Smithfield, and crosses the West Virginia boundary line near Lake Lynn. To the north the Uniontown syncline connects with the Latrobe syncline and to the south it dies out a short distance south of Morgantown, West Virginia.

The synclinal axis is level for two miles south of the Westmoreland boundary, but in the next nine miles it plunges southward 500 feet to a two-mile-long low extending from Monarch to Oliver. Starting at Oliver the axis rises 550 feet to a high point one mile south of Smithfield borough. Beyond this high the axis again plunges gently to the Pennsylvania-West Virginia boundary.

Fayette anticline. The Fayette anticline lies west of the Uniontown syncline but is not quite parallel with it. At the Westmoreland-Fayette County boundary the two are six miles apart, but in southern Fayette County they are only 2½ miles apart. The anticlinal axis enters the county from the north 1½ miles west of Tyrone Mills and trending south-southwest it passes near Flatwoods, Upper Middletown, Haddenville, Balsinger, Woodside, Point Marion, and just east of the Monongahela crosses the Pennsylvania-West Virginia boundary, beyond which point it is called the Indiana[3] anticline.

The strata along this axis lie at a higher elevation in the north part of Fayette County than in the south. In this respect Fayette anticline resembles Laurel Hill anticline, whereas the intervening Chestnut Ridge anticline shows the opposite with the strata lying higher near the southern end. A high point on the Fayette anticline straddles the northern boundary of the county. From this high the axis plunges southward, falling 550 feet in 16 miles to a saddle near Balsinger. Two miles farther the axis rises barely 50 feet above the preceding low, from which point the strata fall very gradually 200 feet in 10 miles to the Pennsylvania-West Virginia boundary line.

The amplitude of the folding along the Fayette anticline is considerably less than along Chestnut Ridge and Laurel Hill anticlines. Between the Fayette anticline and the Uniontown syncline the amplitude of folding is 700 feet at the Fayette-Westmoreland boundary, and increases southward to 850 feet at Waltersburg and West Leisenring, beyond which point it decreases to less than 150 feet in the vicinity of Smithfield and southward to the State boundary. Between the Fayette anticline and the Lambert syncline the amplitude of folding is greater, being 900 feet from Perryopolis to Searights and 600 feet around Masontown. The slope of the strata on the flanks of the anticline is quite regular and about 300 feet in a mile except in the southern part of the county; here the slope is less than 50 feet to the mile on the east flank and 100 feet to the mile on the west.

Lambert syncline. The Lambert syncline and the Brownsville anticline have their northern terminations a few miles west of Perryopolis where they appear as small irregularities on the slope between the Fayette anticlinal axis and the Port Royal synclinal axis. Trending south of southwest they rapidly develop into well formed structures.

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[3] Hennen, R. V. and Reger, D. B. (Geology of) Marion, Monongalia and Taylor counties: West Va. Geol. Surv.

The Lambert synclinal axis passes a short distance east of Redstone, Grindstone, and Davidson, and west of Lambert, where it swings southwest to cross the Monongahela at Gates. The synclinal axis shows a four-mile-long, nearly level, low area straddling Dunlap Creek. Northward from the low, the axis rises 350 feet in nine miles before it dies out; southwestward it rises 100 feet in four miles before crossing Monongahela River into Greene County.

Brownsville anticline. The Brownsville anticline appears as part of the same structural irregularity as the Lambert syncline a few miles west of Perryopolis; thence it trends southwest through Brownsville and crosses the Monongahela into Greene County at East Riverside. The anticline has three minor high points in Fayette County; one west of Redstone, the second northeast of Brownsville, and the third west of Merrittstown; but the high and low points along this axis are differences of only 50 to 100 feet. The eastern flank of this anticline has a very gentle dip, which averages less than 100 feet to the mile and the amplitude of folding on this side is likewise moderate, reaching a maximum of 250 feet near Merrittstown.

Port Royal syncline. The Port Royal synclinal axis enters Fayette County from Westmoreland 1½ miles west of Wickhaven, and trends southwest across the county. It passes east of Fayette City and Troytown and west of Kenneth. The axis crosses the Monongahela into Washington County 2 miles north of Brownsville but recrosses into Fayette County just west of Bridgeport, from which point it trends south-southwest for 5 miles to Arensburg Ferry where it crosses the river a third time and enters Greene County. This syncline is of small depth and the amplitude of folding between it and the Brownsville anticline is only 50 to 100 feet. West of the synclinal axis the strata rise gently onto the Belle Vernon anticline which has an amplitude of 200 or 300 feet on its eastern side.

FAULTS AND JOINTS

Faulting is of minor importance in the structural history of Fayette County. Three faults were observed in this investigation. Two of them are on the western flank of Chestnut Ridge and the third along the Monongahela River. They will be described in detail here because the scarcity of fault exposures makes them interesting. Two of the fault planes were seen; the third was inferred from the displacement of the beds.

A fault was discovered in the north wall of the gulley of Middle Run in German Township, about one-half mile east of the Monongahela River. Its strike is N.45°W. and the dip nearly vertical. The horizontal displacement could not be determined but there was a 3½-foot vertical displacement. The fault was seen about 100 feet above the creek bed where the Waynesburg coal and the sandstone on top of it had been displaced downward on the southwestern side. This fault is approximately parallel with and 100 yards southwest of a peridotite dike which cuts the same strata.

Another fault is exposed in a road cut along the National Pike where it climbs the western flank of Chestnut Ridge at an altitude

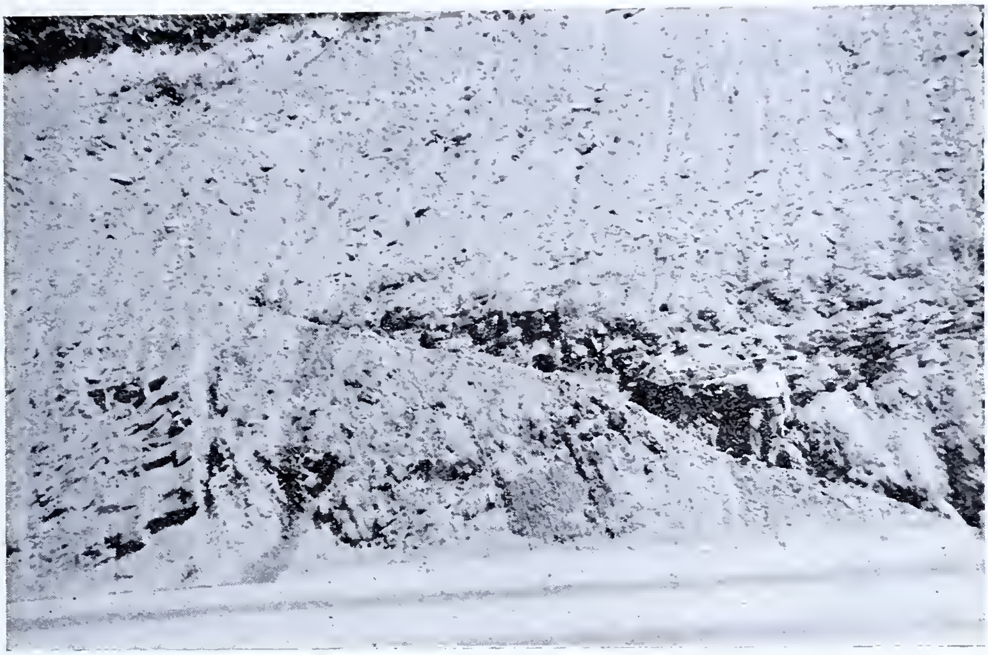

Figure 9. Fault on U. S. Route 40, west flank of Chestnut Ridge.

of about 1,600 feet. It is shown in the photograph, figure 9. The fault appears to strike nearly N.30°E. and the dip is about 30°SE.

Seismograph surveys to determine the rock structure at depths were made on the Chestnut Ridge anticline near Summit in connection with the newly discovered natural gas field. These surveys showed the existence of one or more faults that have sizable displacements. It is not known if these faults extend to the surface. Well logs of some of the gas wells in the Chestnut Ridge gas field more or less substantiate the seismograph findings. These indications, along with the sharpness and amplitude of the Chestnut Ridge anticline, point to a probable subsurface line of echelon faults occurring near the crest of the fold. They may or may not reach the surface.

The third fault is along the Western Maryland Railroad track in the Youghiogheny gorge about 0.7 mile south of the water pumping station across the river from South Connellsville. Here the fault itself was not seen, but the contact of the Greenbrier limestone with the overlying Mauch Chunk red shales has been moved down on the southeast side of a gulley with respect to the same beds on the northwest side of the gulley. That a fault occurs here is clear, but what its dip and strike are could not be determined. The displacement seems to be about 40 to 60 feet.

Limestone and sandstone beds have suffered distortion that has produced a moderate amount of jointing in some places. The joints are commonly oriented in one or two joint systems and are widely spaced. In the limestones jointing can be recognized in many places by weathering along the joint planes, but for the most part it is not apparent in fresh rock. Jointing in sandstones is commonly confined to fairly thick homogeneous beds. It is not found in the cross-bedded

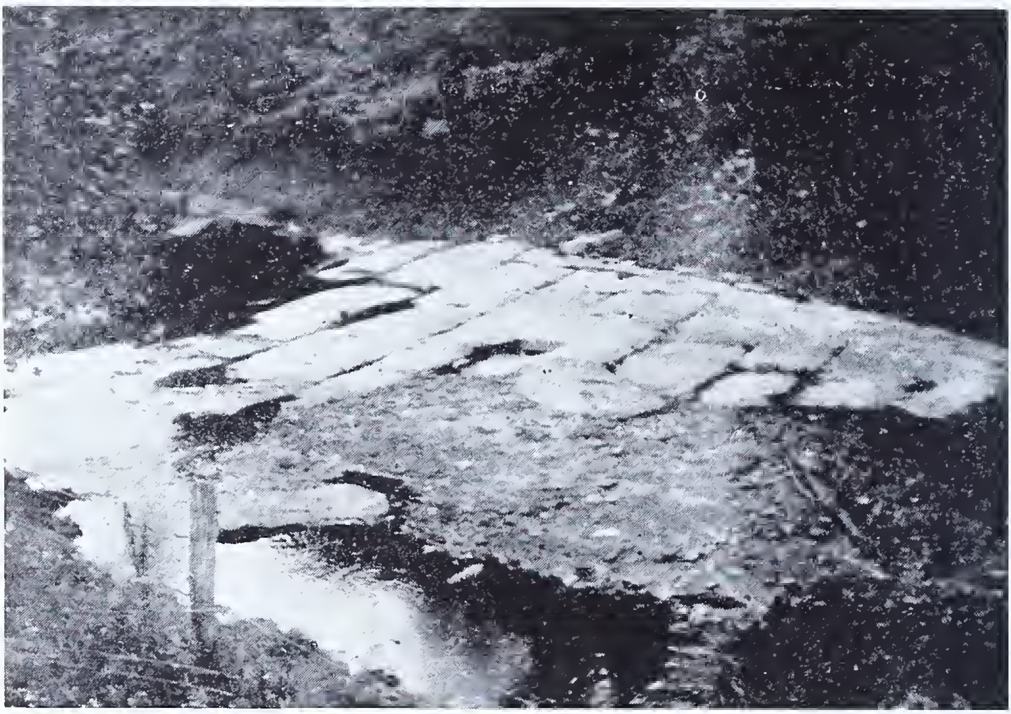

Figure 10. Rectangular jointing in Connellsville sandstone.
Little Jacobs Creek, 2 miles north of New Geneva.

strata where the necessary adjustment attendant on the folding of the beds has taken place by slipping on cross-bedding planes. The Homewood sandstone affords a good example of coarse jointing, however. Along many outcrops on both Laurel Hill and Chestnut Ridge a 20-foot, massive bed forms a broken-down cliff. As weathering has progressed the softer shales under this massive bed have slid out, causing gigantic blocks to break off and creep gradually down hill from the outcrop. These blocks, often 20 by 40 feet in size and as thick as the massive bed itself, are bounded by joint planes which are relatively evenly spaced in the rock and commonly belong to two joint systems at right angles to each other.

SEDIMENTARY ROCKS

BURIED STRATA (PRE-CHEMUNG)

The lowest strata exposed at the surface in Fayette County are of Upper Devonian age. Wells have penetrated below these strata as far as Upper Silurian rocks. The character and thickness of the strata lying below this must be inferred from surrounding areas. From exposures east and west of the Appalachian Plateau it can be seen that the lower Paleozoic rocks are much thicker on the east than on the west.

PRE-CAMBRIAN TO SILURIAN

The character of the pre-Cambrian basement complex under Fayette County is entirely unknown. Where the pre-Cambrian rocks are known in Pennsylvania they are so variable and the unconformity at their top is so great that it would be impracticable to attempt to infer anything about their character under Fayette County.

East of Fayette County in Blair and Huntingdon counties, Silurian, Ordovician, Canadian and the upper part of the Cambrian strata come to the surface. Charles Butts[4] has studied these rocks and reports their character and thickness. In the Mercersburg-Chambersburg region the same strata again appear at the surface and Stose[5] reports their thickness. West of Fayette County the nearest point at which the lower Paleozoic thickness is known is near Waverly, Pike County, Ohio.[6] A deep well at Waverly penetrates into the pre-Cambrian strata[7] and gives the thickness of overlying strata. In Westmoreland County at Ligonier the McCance well has penetrated to the Salina formation, and at McDonald in Washington County a well has penetrated slightly deeper to strata 548 feet below the top of the Silurian. The following table shows the thickness of the pre-Devonian strata as far as they are known:

Thickness of pre-Devonian strata.

	Formation	Waverly, Ohio, feet	Blair-Huntingdon counties, feet	Mercersburg-Chambersburg region, feet*
Silurian	Cayuga	290	1,325	750
	Niagara-Clinton	315	800	750
	Tuscarora		400	500
Ordovician	Juniata		850	425
	Oswego	160	800	150
	Martinsburg Cincinnati	700	1,000	1,200
	Trenton	425	530	425
Canadian	Stones River	300	180	850
	Beekmantown	175	2,100	2,300
	Conococheague	320	2,250	1,635
Cambrian	Elbrook Waynesboro Tomstown	lacking	1,100+	5,000
	Antietam Harpers Weverton	lacking	concealed	4,650
Summary	Silurian	605	2,525	2,000
	Ordovician	1,285	3,180	2,200
	Canadian	795	4,530	4,785
	Cambrian	lacking	1,100+	9,650

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* Amended by A. B. Cleaves, geologist, Pennsylvania Turnpike Commission.

[4] Butts, Charles, Geological section of Blair and Huntingdon counties, central Pennsylvania: Amer. Jour. Sci., 4th ser., vol. 46, pp. 523-537, 1918.

[5] Stose, G. W., U. S. Geol. Survey Geol. Atlas, Mercersburg-Chambersburg folio (No. 170), 1909.

[6] Stout, Wilbur, Geology of Southern Ohio; Geol. Survey Ohio, 4th series, Bull. 20, pp. 658-708, 1916.

[7] Bassler, R. S., The stratigraphy of a deep well at Waverly, Ohio: Amer. Jour. Sci., 4th ser., vol. 31, 1911.

It has been suggested that lower members of the Palezoic strata thin greatly or completely disappear along the line of Allegheny Front, thus bringing the structurally strong pre-Cambrian crystalline rocks much closer to the surface west of the Front and in this manner offering an explanation for the great diminution in the intensity of folding west of this line compared to the folding east of it. For the purpose of this report it will be assumed that the formational thicknesses change regularly from those known on the east to those on the west. That such an assumption may be greatly in error is possible, but it is thought that it will give results which are at least as accurate as those of any other method.

The Blair-Huntingdon section lies about 40 miles east of Fayette County and the Waverly, Ohio, section is 160 miles west. Proceeding on the basis of a regular change in thickness of formations between the two places, the systematic thicknesses under Fayette County are calculated as follows:

	Feet
Silurian	2,100
Ordovician	2,800
Canadian	3,500
Cambrian	1,000+

Basing judgment on the general character of these strata where they are known, it seems probable that the upper half of the Silurian is composed of sandy shales, shaly sandstones and shales with some iron ore near the base. The lower half of the Silurian may be inferred to be predominantly sandstone with a middle red shaly sandstone member. The upper two-thirds of the Ordovician may well be shale with some sandstone lenses, and the lower one-third limestone and limy shale. The Canadian strata would be entirely dolomitic limestone and the Cambrian would be limestone above sandstone and quartzite.

DEVONIAN SYSTEM

(Introduction by Geo. H. Ashley)

The Devonian system is better known in southwestern Pennsylvania than the strata lying below it. First, the upper 1,400 feet are exposed at the surface. Secondly, a great number of gas wells penetrate the upper few thousand feet. Third, since this manuscript was written, several wells drilled on Chestnut Ridge have penetrated almost or quite the full thickness of the Devonian. Unfortunately, when this report goes to press, detailed studies of the drilling samples have not been made. Such interpretations as are given here are based on drillers' records and are subject to correction when the samples shall have been studied. Furthermore, drilling has demonstrated what was suspected, though unproven, that strike faults of considerable throw occur under Chestnut Ridge. A little faulting had been observed and is described beyond. The problem is still further complicated by uncertainty as to the top of the Devonian, in Chestnut Ridge in particular. The Devonian is overlain by the Pocono formation capped by the Loyalhanna limestone. On Allegheny Mountain the Pocono is from 1,000 to 1,100 feet thick. In western Fayette County the Pocono as commonly identified is from 635 to 740 feet thick. On Chestnut Ridge, however, the thickness has been thought to be not over 300 feet; for at that depth below the top, fossils are found that have been identified as of lower Chemung facies which normally should be expected to occur several thousand feet below the base of the Pocono. Two suggestions have been made: first, that the fossils while having the character of the lower Chemung fauna, really represent the descendants of a lower Chemung fauna that have migrated with a shift of environmental conditions, and as those conditions shifted back in middle or early Pocono time, have returned little changed. A second suggestion is that during late Devonian and early Pocono time, a narrow strip of land persisted in the line of what is now Chestnut Ridge, so that no sediments were deposited on that strip of land during that long time, while several thousand feet of Lower Pocono and Upper Devonian sediments were being deposited on both sides of the ridge.

The drilling so far done appears to favor the first explanation, though data are as yet too meager to prove it completely. On Allegheny Mountain, the Pocono, 1,000 to 1,100 feet thick, rests on a thick body of red shales which have been taken to represent the top of the Devonian. A similar body of red shales 300-400 feet thick, called "Catskill" by drillers, or the "Sub-Blairsville red shale" in the Latrobe folio of the U. S. Geological Survey, is reported in drill records throughout most of the plateau area west of Allegheny Mountain, at least as far west as Monongahela River. The top of this zone of red shale appears to occupy a constant horizon which is 1,000 to 1,100 feet below the Loyalhanna limestone on Allegheny Mountain and is about 850 feet below the Loyalhanna limestone at Monongahela River. Unfortunately, none of the deep wells on top of Chestnut Ridge started above the level of the Loyalhanna. But using the structure as shown on the map accompanying this report and the stratigraphy to the Loyalhanna as described elsewhere in this paper, a well near the Summit Hotel where the National Highway crosses Chestnut Ridge, encountered a 398-foot zone of red beds, "Catskill" to the drillers, at 729 feet below the estimated position of the Loyalhanna. This appears to fit in with the idea that the stratigraphy across Chestnut Ridge is normal for the general region.

These deep wells all go down to the identifiable Onondaga limestone and Oriskany sandstone. On Allegheny Mountain, the top of the Onondaga limestone is about 8,350 feet below the Loyalhanna limestone. In a well near McDonald, west of Pittsburgh, the two limestones are almost 5,600 feet apart. Chestnut Ridge is a little east of halfway (about 3/5) between the McDonald well and Allegheny Mountain. If the formations thickened uniformly from the well to the mountain, we would expect the interval under Chestnut Ridge to be about 6,650 feet.

The Leo F. Heyn No. 1 well struck the limestone at about 7,000 feet below the estimated position of the Loyalhanna limestone. This is in general accord with the recorded or estimated interval in other wells both on top and sides of Chestnut Ridge. This certainly does not suggest the absence of 2,000 feet or more of Upper Devonian and

Lower Pocono strata in Chestnut Ridge, and again appears to support the idea that the Pocono and Devonian are normal under Chestnut Ridge, and that the fossils found about 300 feet below the Loyalhanna limestone are in the lower middle part of the Pocono and represent a "return engagement" as the theater people say. Juxtaposition owing to faulting has been suggested. However, as this fauna has been reported at several widely separated places, the probability of similar faulting producing similar juxtaposition at places ten miles apart seems highly improbable.

Recently the writer has raised a third question. The lower part of the Pocono and the upper part of the Devonian are unfossiliferous except in the northwest corner of Pennsylvania. There the line between the Devonian and Mississippian has been drawn at the base of the Berea sandstone. Recent detailed work has tended to correlate the red zone, "Catskill" or "Sub-Blairsville," with red shales that occur at least 100 to 200 feet below the base of the Berea, suggesting that the basal Pocono on Allegheny Mountain is uppermost Devonian in age and probably equivalent to the Oswayo formation of northern Pennsylvania and that the red zone is the equivalent of the Cattaraugus of that part of the State.

This interpretation, if correct, further complicates the matter of drawing the top of the Devonian. In the western part of the county, where the Venango sands are thought to have been identified, the top of the Devonian is drawn traditionally in accord with the above interpretation, at the base of the Berea or Murrysville.

The Devonian of northwestern Pennsylvania has been subdivided as follows:

Upper Devonian: Chautauqua series
  Conewango group
    Oswayo member
    Cattaraugus member

  Conneaut group
    Chadakoin member
    Girard member

  Canadaway group
    Northeast member
    Westfield member
    Gowanda member
    Dunkirk member

Upper Devonian: Seneca series
    Chemung member
    Portage member
      Genesee sub-member

Middle Devonian series
    Hamilton member,
      including Marcellus black shale
    Onondaga limestone member

Lower Devonian series
    Oriskany member
    Helderberg member

At this time it is not possible to identify these series or members in southern Pennsylvania, except in a few instances. The Oswayo is identified with the strata from the base of the Berea or Murrysville to the top of the red beds (Cattaraugus or "Catskill" of the drillers). Below the red beds it has been customary to call everything "Chemung" down to a point where the sediments become predominantly dark shales. These dark shales, often black ("Genesee") at the bottom, are called Portage. The Tully limestone, if it is present, immediately underlies the Genesee black shales. Below that is the Hamilton, much of which may be black shale or limy in western Pennsylvania, bringing the section down to the top of the Onondaga limestone. Below that come the Oriskany sandstone and Helderberg limestone.

Pending future studies which may lead to the identification of the sub-divisions listed above, drill records are interpreted as: Pocono, Catskill, Chemung, Portage, Tully, Hamilton, Marcellus, Onondaga, Oriskany and Helderberg. So interpreted the section of the Devonian under Fayette County appears to average:

Mississippian		Feet
Pocono (basal part Devonian?)		850
Devonian		
"Catskill" facies	450–350	350
"Chemung" and "Portage" facies		5300
Tully limestone		95
Hamilton and Marcellus		575
Onondaga limestone		170
Oriskany		100
Helderberg		350

This indicates a total from the top of the red beds to the top of the Onondaga limestone of about 6,200 feet, including about 350 feet of Catskill, 5,300 feet of combined Chemung and Portage, 95 feet of Tully and 575 feet of Hamilton and Marcellus. Sections east of Chestnut Ridge are likely to be thicker, those west to be thinner, and drillings on Chestnut Ridge may, because of crossing fault planes, differ materially from those figures. Attempts to separate the "Chemung" and "Portage" led to such diverse results that the two are combined here. In view of the uncertain occurrence of the Tully limestone in the area of its outcrop, too much weight must not be given to its exact identification in these wells.—G. H. A.

THE UPPER DEVONIAN IN WELLS

A discussion of the uppermost 500 feet of the Devonian will be found in the next section. Several wells in Fayette County have gone deeper than the strata exposed at the surface and one has probably passed completely through Chemung and into Portage beds. These wells show the upper part of the Devonian to consist of sandstone and shale. A zone 200 to 400 feet thick immediately below the Pocono is gray shale with numerous sandstone beds. Next lower comes a 100- to 300-foot zone of red shale with abundant sandstone at the top and a few scattered lenses of sandstone in the middle. This represents Catskill sedimentation.* Below the Catskill there is a zone 200 to 400 feet thick in which the sediments are predominantly sandstone with a moderate amount of interbedded gray and buff shale between. The lowest sand of this group is commonly called the Elizabeth by the local drillers and is a good gas-producing horizon. Nearly all the wells in Fayette County stop after passing this bed. A few, however, go deeper and tell us something of the lower strata. Below the Elizabeth group of sands an entire interval of 800 to 900 feet is shale. Below this 20- to 40-foot beds of sandstone occur at intervals of 200 to 500 feet. The deepest well in Fayette County, except those on Chestnut Ridge, encountered 40 feet of hard sandstone approximately 3,000 feet below the Pocono sandstone. This may represent the Parkhead sandstone of the Maryland Survey which lies at the top of the Portage. The fact that the McCance well shows a post-Portage Devonian thickness of 3,000 feet would add assurance to that assumption. Below this sandstone there are 1,750 feet of shales with only two thin sandstone beds, which abundance of shale and lack of sandstone is typical of the Braillier shales of the Portage group.

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* Catskill is a facies term for non-marine (usually red) Devonian.

EXPOSED DEVONIAN STRATA*

CHEMUNG AND POST-CHEMUNG

Beds of Devonian age are the oldest rocks exposed in Fayette County. They crop out along Laurel Hill and Chestnut Ridge wherever streams have cut deeply into the core of the ridges. A complete section from the top of the Devonian downwards was found nowhere in the county but several exposures were found at which considerable thicknesses could be measured. On the whole, Devonian outcrops are very poor.

On Laurel Hill, Devonian strata crop out in the gorge of the Youghiogheny and near the headwaters of Fulton Run, South and Middle forks of Laurel Run, Neals Run and Trout Run. The only exposure worth mentioning, however, is the one in the Youghiogheny gorge. Here 280 feet of the Catskill red facies can be seen on the south bank of the river across from Victoria. The red beds lie directly under the Pocono sandstone and conglomerate and consist of red shales interbedded with red and brown sandstone. What lies immediately below the 280 feet of red beds is not known.

On the north bank of the river east of Victoria another exposure begins about 200 feet lower stratigraphically. A section at this exposure gives:

Section of lowest Devonian strata in Youghiogheny gorge in Laurel Hill

Feet	
60	Brownish shale and weak sandstone
20	Hard gray sandstone and quartz conglomerate
25	Concealed
10	Hard, micaceous arkosic sandstone (fossiliferous at top)
70	Sandstone and concealed to river bed.

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* In view of the unproven status of the conclusions presented above in the "Introduction" to the Devonian, this section and that on the Pocono beyond are left as they were written. If, however, the conclusions there voiced prove to be correct, all of the rocks between the Loyalhanna and top of the red beds are of Pocono age, and the massive sandstone called "Berea" may be the Berea, though the Berea actually belongs 200-250 feet above the top of the red beds. G. H. A.

The only fossils found in this entire thickness of Devonian are some pelecypod shells in the 10 feet of hard sandstone. Estimating the total thickness of exposed Devonian at this point gives about 665 feet, thus making the fossiliferous beds approximately 585 feet below the Pocono.

In Chestnut Ridge Devonian rocks are exposed in the gorge of Youghiogheny River and in each of the hollows along the west flank of Chestnut Ridge south of Jumonville and in many of the hollows along the east flank south of Summit. Partial sections were made at the exposures in the Youghiogheny gorge and along the National Pike east of Hopwood. In the Youghiogheny gorge it was not possible to measure a section at the top of the Devonian, but exposures are good enough to show that no red beds of the Catskill facies occur in the upper 150 feet. In all, 500 to 600 feet of Devonian strata are exposed and a section was measured along the Western Maryland Railroad tracks on the east flank of the anticline. The section begins about 250 feet below the Pocono and extends downward for 180 feet.

Devonian section in Youghiogheny gorge in Chestnut Ridge

Feet	
	Concealed
15	Reddish brown shale
10	Concealed
25	Hard brownish sandstone
20	Shale and concealed
20	Hard sandstone
2	Shale
3	Sandstone
15	Reddish brown shale
5	Massive sandstone
3	Red clay shale
2	Cross-bedded sandstone
6	Massive sandstone
6	Red-stained gray shale
6	Massive sandstone
2	Sandy shale
1	Hard shale
1	Fissile shale
20	Massive sandstone with three 6″ beds of clay shale
18	Massive sandstone
	Concealed

In the section given above the Catskill red beds appear about 250 feet or less below the Pocono sandstone and extend downward for some distance. This part of the Devonian contains a good deal of sandstone. On the north bank of Youghiogheny River approximately opposite the upper end of this section, Bradford Willard has found a zone containing fossils of late Devonian age (Chemung or younger).

Along the National Pike east of Hopwood a section of the lower part of the Pocono was obtained. Unfortunately a fault displaces the strata shortly below the base of the Burgoon sandstone and it is not possible to give a complete section.

Devonian section along National Pike east of Hopwood

Feet		
25	Massive gray sandstone	(basal Burgoon)
25	Dark gray shale	(fossiliferous)
	Fault displaces strata	
15	Medium to heavy-bedded fine-grained sandstone	
6	Shale and sandstone	(fossiliferous)
8	Hard sandstone	
6	Sandy shale	
5	Iron-stained sandy shale	
4	Sandstone	
5	Sandstone and shale	
20	Shale with thin sandstone beds	
5	Brown sandstone	
5	Shale and sandstone	
4	Hard brown sandstone	
20	Concealed	
10	Shale and gray sandstone	
	Concealed	

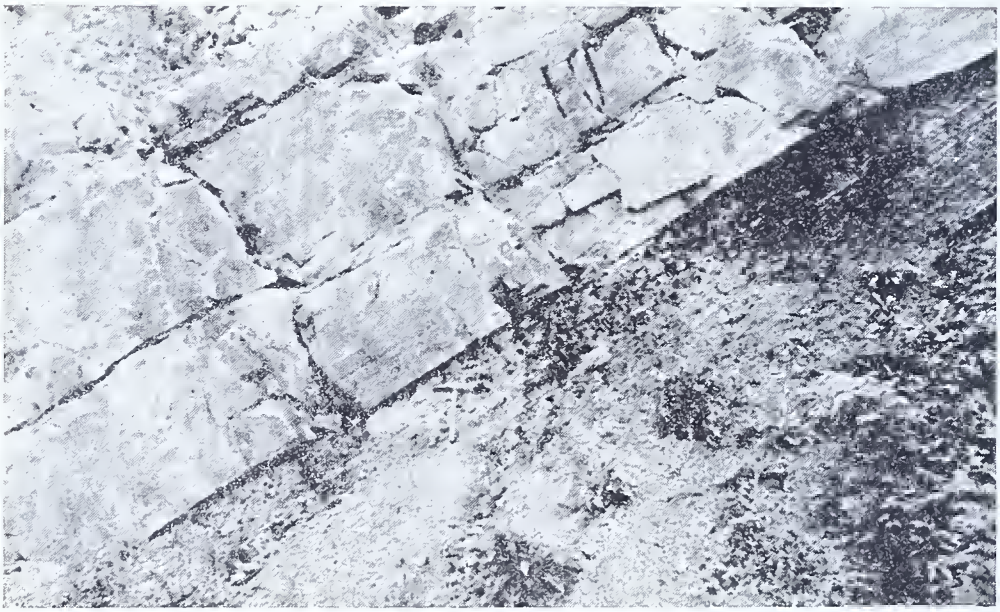

Figure 11. Mississippian-Devonian contact.
Pocono sandstone resting on dark gray shale, 1½ miles east of Hopwood on U. S. Route 40.

The faunas discovered in the uppermost beds will be discussed below in the section on age and correlation.

Near the top of Chestnut Ridge at Summit, another section of Devonian strata was measured. Calculations show the top of this section to lie about 150 feet below the Burgoon and it may be a continuation of the section just given.

Section of Devonian along National Pike near Summit

Feet	
150±	Concealed to Burgoon
15	Gray sandstone with minor shale
3	Quartz conglomerate
5	Conglomeratic storm rollers in a very pebbly matrix
2	Sandy shale
40	Massive to thick-bedded, fine-grained gray brown sandstone ("Berea"?)
	Concealed

This section is predominantly sandstone and might be taken for part of the Pocono except for the fact that fossils were found in the overlying beds. Three hundred feet more of Devonian strata crop out below the highway, but talus is so thick that little can be told about the bedrock.

Age and correlations. (By G. H. A.) A report on the deep drilling on Chestnut Ridge, received from Chas. R. Fettke in February, 1940, is given in full in progress report 124 of the Survey series and in abstract elsewhere in this volume.

With the evidence now available it seems clear that the section on Chestnut Ridge is normal. It strengthens the suspicion held recently that the Pocono formation of Allegheny Mountain is not the equivalent of the "Pocono" formation of the oil and gas fields of western and northwestern Pennsylvania. This is brought out in figure 12. The Pocono of Allegheny Mountain extends from the base of the Loyalhanna limestone to the top of a thick body of red strata. The "Pocono" of northwestern Pennsylvania extends from the base of the Mauch Chunk to the base of the Berea sandstone. Immediately below the Berea in a wide area in northwestern Pennsylvania is a thin bed of red shale of Bedford age. In that area it is 100 to 200 feet from the base of the Berea to the top of the Venango first sand. A little farther east and 100 feet or more below the top of the Venango first sand (Gantz sand of this report), occurs the top of a body of red beds,—Cattaraugus of reports on northwestern Pennsylvania. It now appears highly probable that these red beds at 200-300 feet below the base of the Berea sandstone are the equivalent of the red beds immediately underlying the Pocono in Allegheny Mountain.

In figure 12, the first section from near Deemston, just west of Fayette County, shows the Berea sandstone typically overlying the Bedford red shale, giving a definite boundary, as at present agreed to, between the Mississippian and Devonian. The same well section also shows red beds below, the top of which are 220 feet below the base of the Berea. Traced eastward through selected wells, the interval between the Loyalhanna limestone and the top of the lower red beds continues to be about 850 to 900 feet, suggesting that the base of the Berea should be looked for about 225 to 250 feet higher. It is stated above in this report that what was considered to be the base of the Mississippian occurs on Chestnut Ridge about 250 feet above the red beds. Just at that elevation above the red beds occurs a shale with fossils correlated as of Devonian age, overlain by a massive sandstone.

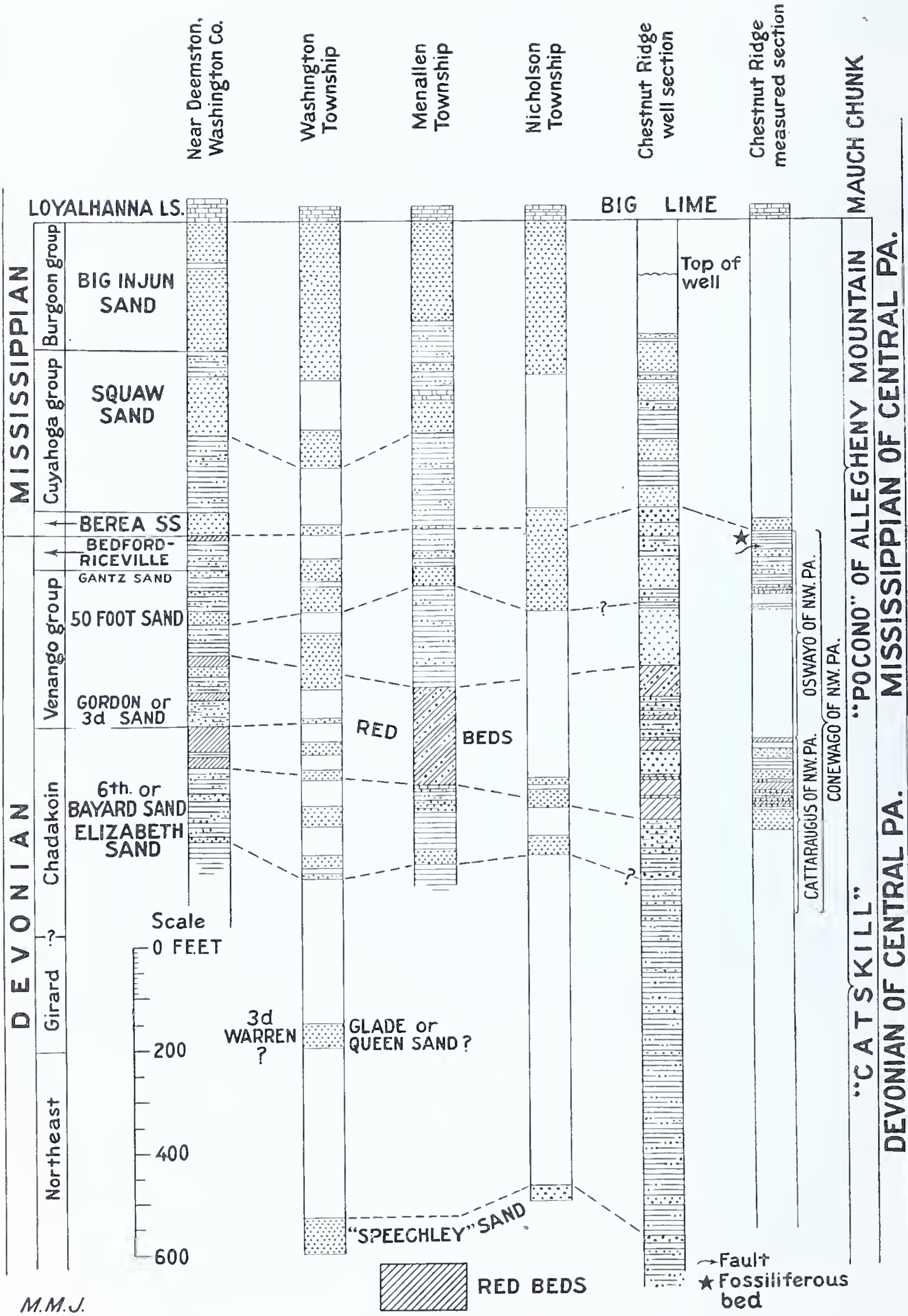

Figure 12. Columnar sections of super-Devonian strata.

The following fossils collected by Stevenson on Chestnut Ridge were identified by James Hall:[1]

1. *Lingula,* sp.
2. *Discina grandis?*
3. *Spirifer disjunctus*
4. *Rhynchonella stephani*
5. *Streptorynchus chemungensis*
6. *Palaeoncilo maxima*
7. *Sanguinolites rigida*
8. *Sanguinolites clavulus*
9. *Sanguinolites ventricosa*
10. *Mytilarca chemungensis*
11. *Pteronites,* sp.
12. *Actinodesma recta*
13. New and undt. form
14. *Orthoceras crotalum?*

Stevenson listed this faunule as lower Chemung. Willard[2] obtained and identified the following from cuts along the National Pike east of Uniontown.

"Worm trails"
Crinoidea, columnals
Bryozoa, indt.
Stropheodonta cf. *demissa* (Conrad)
Productus?
Dalmanella?
Camarotoechia congregata var. *parkheadensis* Clarke and Swartz
C. contracta (Hall)
C. contracta? (Hall)
C. eximia (Hall)
Liorhynchus?
Spirifer disjunctus Sowerby
S. mesacostalis Hall
Brachiopod, indet.
Glossites linqualis Hall
Cypricardella sp.
Pelecypod, indet.
Orthoceras cf. *pertextum* Hall
Fucoids
Plant fragments

These faunules have strongly the aspect of the lower Chemung of Maryland or Cayuta of New York. However, as stated in the "introduction" (p. 32), the strata from which they were obtained are reported to occur only 300 feet or less below the Loyalhanna limestone, which would seem to put them in the middle of the Pocono formation. Caster[3] questions if the form identified as *Spirifer disjunctus* is not a mutant, that, with species of *Pararea* and *Ptychopteria*, indicate a Conewago age, probably Oswayo, or uppermost Devonian of northwestern Pennsylvania and probably basal Pocono of the Allegheny Front.

If, however, as discussed in the "Introduction" by G. H. A., these fossils occur only 300 feet below the Loyalhanna limestone, they would appear to belong in the middle of the Pocono and to be lower Pocono in age. However, Mr. Fettke's report just received shows that all the wells start below the Loyalhanna limestone and three of them reach the top of the red beds at depths of 727 to 759 feet. If the fossiliferous stratum is less than 250 feet above the red beds, these wells show that the fossiliferous bed is at least 500 feet below the Loyalhanna, plus the distance of the tops of the wells below that stratum. It, therefore, appears probable that the shale from which the fossils came is uppermost Devonian in age—Riceville or upper Oswayo, or uppermost Conewago. This conclusion was greatly strengthened by finding last fall (1939) that the similar fossils reported[1] in the gorge of Conemaugh River west of Johnstown came from the lower part of the Pocono, as identified at that point, the red beds having been found in their normal place a short distance below them.

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[1] Pennsylvania Second Geol. Survey. KKK, p. 311, 1878.

[2] Willard, Bradford, Chemung of southwestern Pennsylvania: Proc. Pa. Acad. of Science, vol. VII, 1933, p. 151.

[3] Willard, Bradford, and Caster, Kenneth E., Age of Devonian of southwestern Pennsylvania; Am. Assoc. of Petroleum Geologists Bull., vol. 19, no. 10, 1935, p. 1547.

Figure 12 shows on the left the correlations recognized in the northwestern corner of Pennsylvania, where marine fossils are abundant and detailed tracing has been done by Chadwick, Caster, Cathcart and others.[2] The lower red beds are lacking in Erie and Crawford Counties. Further east the uppermost Devonian is divided into the Oswayo and Cattaraugus formations, together constituting the Conewago group. The Oswayo extends from the base of the Berea or Knapp formation to the top of the red beds, which are treated together as Cattaraugus. In central Pennsylvania, the subdivision has been Pocono, Catskill, Chemung, etc. It is now recognized that these are all facies names, and that the lower Pocono is probably Oswayo in age, as indicated on the extreme right of figure 12.

See text elsewhere on Summit Gas Pool, by C. R. Fettke.

MISSISSIPPIAN SYSTEM

Mississippian rocks crop out along Chestnut Ridge and Laurel Hill anticlines in Fayette County. The system falls into three lithologic units which are quite distinctive. The lowest division is the Pocono formation or group which underlies unconformably the Loyalhanna siliceous limestone on which lies the Mauch Chunk formation.

POCONO FORMATION

Character and thickness. The Pocono is predominantly sandstone, but it also contains some shale, especially in the lower part. The sandstone is commonly gray, hard and coarse-grained. Conglomeratic beds, usually two or more, are common but not of great thickness. The pebbles of white quartz are small, about the size of peas. Some investigators have considered that these conglomerates can be differentiated from those of the Pottsville series because the pebbles in the Pocono are flattened and the pebbles in the Pottsville are round. The writer in using this method to differentiate the two came to the conclusion that difference in roundness of the pebbles is not sufficiently marked in Fayette County for practical use. The shale is gray to greenish-gray, commonly sandy and occurs between sandstones in beds a few feet to 25 or 30 feet thick. As the shale occurs mostly in the lower part of the formation, it is seldom exposed but is hidden by the talus from the overlying thick-bedded sandstones.

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[1] Willard, Bradford, loc. cit. p. 152.

[2] Chadwick, Geo. H., Unpublished papers and the following:
Chemung stratigraphy in western New York (abst.): Geol. Soc. America Bull. vol. 32, no. 1, p. 91. Mar. 31, 1921.
The stratigraphy of the Chemung group in western New York: New York State Museum Bull. 251, pp. 145-147, 1924.
Chagris formation in Ohio: Geol. Soc. America Bull. vol. 36, no. 3, pp. 455-464, Sept. 30, 1925.
Caster, Kenneth E., The stratigraphy and paleontology of northwestern Pennsylvania. Part 1, Stratigraphy: American Paleontology Bull., vol. 21, Ithaca, 1934.
Cathcart, Stanley H., and C. R. Fettke, Geology and possibility of deep sand oil and gas production in northwestern Pennsylvania: Pennsylvania State College, Min. Indus. Experiment Sta. Bull. 19, p. 91, 1935.

The outcrops of Pocono are generally marked by light-colored sandstone blocks, but it is rare that any bedrock is seen in place. A good exposure can be seen along the National Pike 1.3 miles east of Hopwood on the western flank of Chestnut Ridge where the following section was measured.

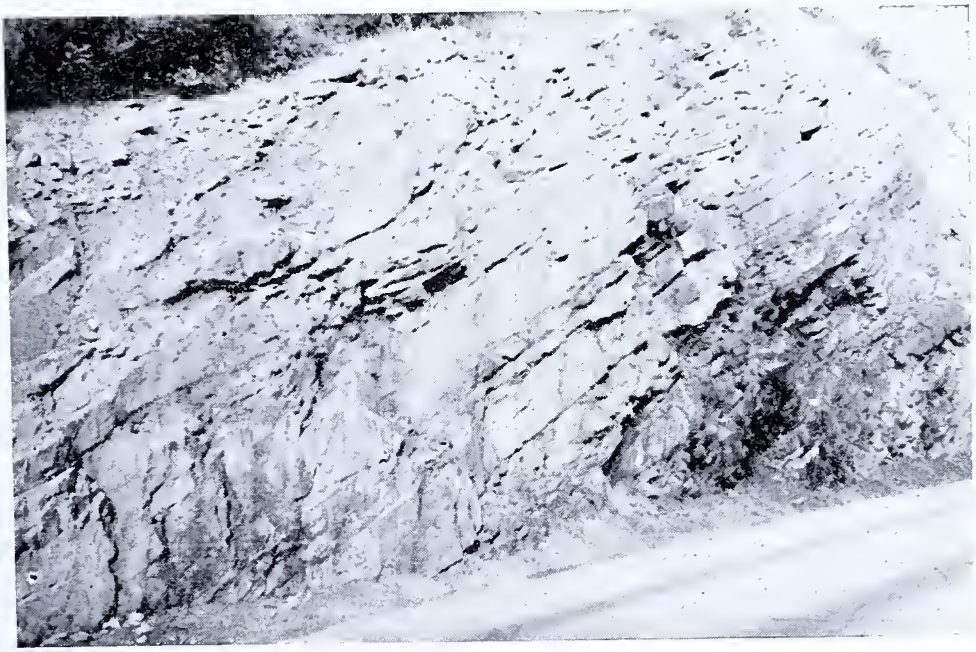

Figure 13. Pocono sandstone 1½ miles east of Hopwood on U. S. Route 40.

Pocono section 1.3 mile east of Hopwood

Feet	
	Concealed
30	Massive gray sandstone
150	Concealed (gray sandstone)
70	Very massive gray sandstone
4	Hard gray conglomerate
8	Shale and shaly sandstone
25	Massive gray sandstone (brown stains)
	Dark gray shale (fossiliferous) Devonian
287	

This section is not complete as the top of the Pocono is hidden. It seems probable that the average Pocono thickness is close to 300 feet, and that the formation is seldom less than 250 feet thick. Another good Pocono exposure lies along the Western Maryland Railroad in the Youghiogheny gorge on the western flank of Chestnut Ridge. This exposure is 9 miles northeast of that on the National Pike. The section was measured as follows:

Pocono section near South Connellsville

	Feet	
	58	Siliceous limestone (Loyalhanna)
240+	55	Massive gray cross-bedded sandstone
	30	Concealed
	3	Sandy shale
	30	Weak sandstone and shale
	30	Sandstone with thin shale beds
	5	Shale (plant remains)
	25	Irregular-bedded gray sandstone
	30	Thick-bedded gray sandstone
	12	Sandy shale
	20	Massive gray sandstone
250		Concealed
		Shaly sandstone 25′, Devonian ?
		Concealed
	10	Gray pebbly conglomerate, "Berea"

In this section the basal part of the Pocono is not exposed and so again a total thickness cannot be determined. However, it seems improbable that it is much greater than 300 to 350 feet.

Subdivisions of the Pocono. The Pocono has been divided into three formations in western Pennsylvania and Ohio—the Berea sandstone at the base, the Cuyahoga shale in the middle and the Burgoon sandstone at the top. Whether all three of these divisions are present in Fayette County is not known. It seems more probable that they are not, but the incomplete knowledge of the make-up of the series renders a definite statement inadvisable. The middle of the Pocono is composed of less massive sandstone than the upper and lower parts and also contains some shale. Therefore it might correspond with the Cuyahoga shale, with the Burgoon above, and the Berea below, but the differences are not clearly marked and the whole may constitute the Burgoon, with the Berea, if present, lying below the shale containing ''Devonian'' ? fossils.

The oil and gas well records and the correlations of J. D. Sisler (1933) and J. French Robinson (1930) indicate the presence of the ''Berea'' sand in the oil wells 600 feet below the top of the Big Injun (top of Pocono) sand. Exposures along the National Pike west of Summit and in the gorge of the Youghiogheny River through Chestnut Ridge show a massive sandstone and conglomerate 550 to 600 feet below the base of the Loyalhanna limestone. It seems probable that this sandstone corresponds with the ''Berea'' sand of the well records. In the northern part of the State, and in Ohio, where the type section of the Berea occurs, it is definitely Mississippian in age, whereas in Fayette County the conglomeratic bed reported 600 feet below the top of the Big Injun underlies shales in which ''Devonian'' fossils have been found. This throws considerable doubt on the subsurface correlation of the Fayette County ''Berea'' with the Berea sandstone of the type locality, and although the name Berea will not be discarded in this report because of its long use, whenever it is used in this report referring to the Fayette County sand, it will be placed in quotation marks.

Areal distribution of the Pocono. Pocono sandstone outcrops are confined to Chestnut Ridge and Laurel Hill. On Chestnut Ridge north of the Youghiogheny River outcrops of the Pocono are confined to the western flank, where the upper part has been exposed along Green Lick Run, Mounts Creek, Butler Run, Breakneck Run and Connell Run. There are extensive exposures of the Pocono in the Youghiogheny gorge and along Dunlap Creek. Around Jumonville and along the ridge the Pocono lies relatively higher, so that it caps the ridge and extends down both flanks. In the Wymps Gap area near the State line, the sandstone is plunging southward and again it is exposed only in the stream valleys.

On Laurel Hill the exposures of Pocono sandstone are more extensive. North of the Youghiogheny gorge Laurel Hill is topped by two ridges facing each other across a small valley which is floored by Pocono sandstone. South of the gorge the strata plunge southward so that the Pocono is exposed only in a small area around Sugarloaf Knob and in the valley of Beaver Creek at Beaver Creek School.

The presence of the Pocono west of Chestnut Ridge is shown by many well drillings, but nowhere does it appear at the surface. Correlations of the sands in these well records indicate a thickness for the Pocono of more than 600 feet.

Age and correlation. No fossils have been found in the Pocono formation in Fayette County and its correlation with other regions must be by means of lithology and tracing through well logs. Eastward across Pennsylvania the Pocono can be traced by successive outcrops into eastern Pennsylvania. The thickness increases rapidly eastward from Fayette County, and the series is in three or more distinct parts from the Somerset-Windber[8] region eastward. Its age is placed as early Mississippian.

To the north and west the Pocono passes below the surface and is known only in well records. The upper massive part, however, which is called the Big Injun sand by the drillers, is easily traceable from well to well, being the most persistent sand known in the region. Thus the upper Pocono is correlated with the Logan formation of southern Ohio which is regarded as Burlington in age (Butts).[9]

LOYALHANNA SILICEOUS LIMESTONE

Character and thickness. The Loyalhanna is predominantly a homogeneous, massive, cross-bedded sandstone with calcareous cement. Gray-colored when fresh, commonly it weathers light gray, but in a few places where the iron content is above the average, weathered surfaces are stained buff to yellow. Irregular masses of reddish material are found in the homogeneous gray rock. These are not related to the bedding, but are the product of secondary silicification, which has taken place throughout the formation.

The rock is composed predominantly of quartz grains and calcitic oölites cemented by calcite. It contains also a few rounded grains of crystalline calcite. Several thin sections of the rock and about 20 insoluble residues were studied. Microfossils seen in the thin sections will be discussed under the heading of age and correlation. All the quartz grains, which vary in size from 1 mm. to .01 mm., are distinctly frosted and although commonly subangular they have their points rounded. Although all grain sizes between the limits mentioned above were found in the Loyalhanna, individual specimens are composed of grains falling into one- or two-size groups of narrow limits. If only one size of grains occurs in a specimen, commonly it is within the limits .10 to .05 mm.; one specimen contains grains of finer size. When grains of two sizes are present, the larger grains commonly lie within the limits .5 to .2 mm.; a few specimens showing grains larger than .5 mm. had a lower limit of .3 to .4 mm. and a few specimens had large grains between the sizes 2 and 1 mm. The fine-grained part in these specimens varied from .05 to .02 mm. commonly, but in a few cases grains so small as .01 mm. were seen.

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[8] Richardson, G. B., U. S. Geol. Survey Geol. Atlas, 1934. Somerset-Windber folio (No. 224).

[9] Butts, Charles, Mississippian series of eastern Kentucky: Kentucky Geol. Survey, 1922, p. 50; 1924, p. 254 (see bibliography).

All the quartz grains do not appear to come from the same source. Most of the grains are composed of unicrystalline quartz which has sharp extinction under crossed nicols. Others show undulatory extinction similar to that produced by strain, whereas still others show a multicrystalline structure similar to that found in recrystallized quartzites. In some of the multicrystalline grains the crystal boundaries are regular, giving a mosaic fabric of even-sized particles. On the other hand, some of the crystal boundaries are minutely irregular and sutured. Some of the quartz grains, quite irrespective of the types as shown above, contain dark staining material thought to be limonite. This stain is related to individual grains and not to areas in the rock and so was acquired by the quartz before its deposition in the Loyalhanna. Some quartz grains contain minute needles of apatite and one was seen with included zircon crystals, both of which indicate an igneous origin for those grains.

Calcite grains and oölites are common in the Loyalhanna. The siliceous and calcareous content is quite variable and in rock which has a low siliceous content oölites are abundant and grains of calcite are frequent. The oölites commonly are so stained with opaque material that the crystallinity of the calcite is not apparent, but in a few cases a radial structure was observed. Oölites are present in all the thin sections of the rock, but become abundant only in material that has less than 40 percent insoluble residue. Rounded grains of clear unicrystalline calcite are present in several thin sections. These grains do not look like oölites, but rather appear to be calcitic sand grains that were included in the detritus which accumulated during the formation of the rock itself.

In addition to the quartz and calcite mentioned above, tourmaline, biotite, chlorite, feldspar, olivine (?) and black opaque mineral grains were observed. Several sections show small elongated tourmaline grains which are poorly rounded. Biotite particles and flakes are numerous in most of the sections and one section shows a few green chlorite grains. Two sections contain several grains of highly altered feldspar and one a single grain of what appears to be microcline.

Another section has a grain of a clear mineral with moderately high indices and birefringence which has the appearance of olivine but might be an orthorhombic pyroxene. The most abundant accessory constituent is the black opaque grains that were observed in nearly all the sections. In some sections this mineral is rounded detrital grains and in others it has the appearance of a secondary mineral replacing not only the calcite cement but also some of the mineral grains, notably quartz and biotite. The matrix cementing the grains of the rock is calcite in all the sections studied. In a few cases the calcite is contaminated with clay matter or is partly altered to biotite. Commonly, however, it is fairly pure and coarsely crystalline. None of the sections shows silification of the cement, although field examination of some of the material indicates that complete silification of the carbonates has taken place in parts of the upper beds of the formation. The great variation in the calcareous content of the rock is due to the relative abundance of granular or oölitic calcareous material and not to variations in the cement.

Cross-bedding is the most striking feature of the Loyalhanna. Although it is nearly invisible on fresh surfaces, it stands out on a surface that has been exposed long enough for weathering to emphasize the inequalities of the individual beds. In thin section the beds are seen to be alternating bands of coarse and fine quartz grains. In the coarse-grained bands, quartz and other insoluble material are commonly much more abundant than in the fine-grained bands. This leads to differential solution and the coarse-grained bands stand out as ridges on the surface of the rock, thus making the bedding visible. The individual beds, 1/10 to 1 centimeter in thickness, form sequences that may be as much as 4 or 5 feet thick. These sequences are commonly cut off on each end at steep angles to the bedding by other sequences of beds of similar extent and character. The greater part of the total Loyalhanna thickness is commonly built up in this manner. The bedding planes of individual sequences may be slightly curved. The angle of dip of the beds of individual sequences in relation to the Loyalhanna boundaries is completely irregular and no general trend of dip could be worked out.

A peculiar phase of the Loyalhanna was seen along the eastern flank of Chestnut Ridge a few miles south of Summit. At this point a cross-bedded sandstone lies directly below the red Mauch Chunk shale in the position normally occupied by the calcareous Loyalhanna. Since the cross-bedding of the sandstone is of the Loyalhanna type, rather than the even-bedded, cross-bedding of the Pocono it seems more probable that this loosely-cemented sandstone is the Loyalhanna without its calcareous cement. Whether the calcareous cement has been removed by weathering, or was never deposited could not be determined here, but from evidence in Dulany Cave on the west side of the ridge it seems probable that this phase is mere weathering of the lime from the outcrop, leaving only sand grains on the surface. In other places, where no outcrops of Loyalhanna have been found between the Mauch Chunk and the Pocono, the same state of affairs may occur and the Loyalhanna may not necessarily be lacking as has been assumed to be the case in the past.

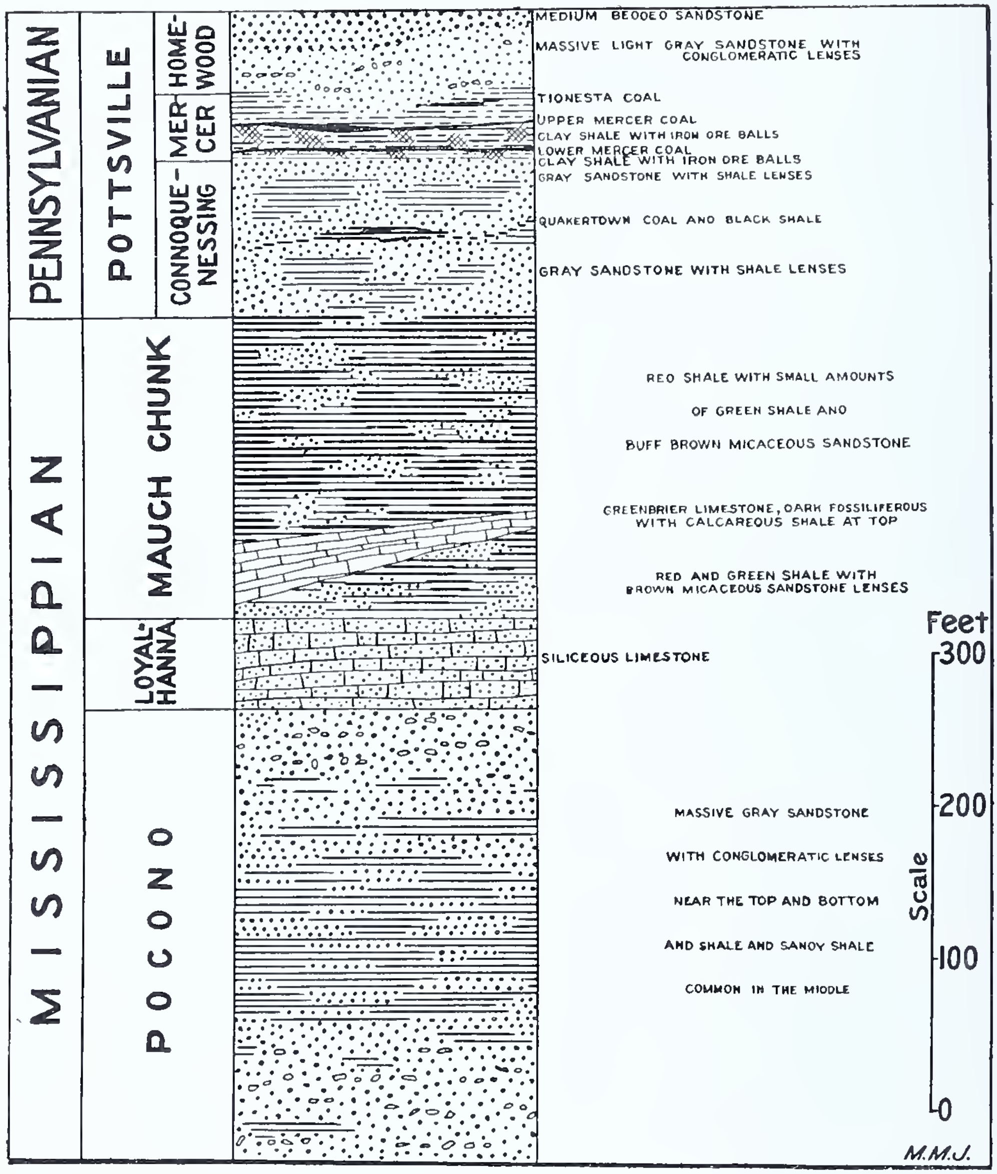
PENNSYLVANIAN
POTTSVILLE
HOMEWOOD
MERCER
CONNOQUENESSING
MISSISSIPPIAN
MAUCH CHUNK
LOYALHANNA
POCONO
MEDIUM BEDDED SANDSTONE
MASSIVE LIGHT GRAY SANDSTONE WITH CONGLOMERATIC LENSES
TIONESTA COAL
UPPER MERCER COAL
CLAY SHALE WITH IRON ORE BALLS
LOWER MERCER COAL
CLAY SHALE WITH IRON ORE BALLS
GRAY SANDSTONE WITH SHALE LENSES
QUAKERTOWN COAL AND BLACK SHALE
GRAY SANDSTONE WITH SHALE LENSES
RED SHALE WITH SMALL AMOUNTS OF GREEN SHALE AND BUFF BROWN MICACEOUS SANDSTONE
GREENBRIER LIMESTONE, DARK FOSSILIFEROUS WITH CALCAREOUS SHALE AT TOP
RED AND GREEN SHALE WITH BROWN MICACEOUS SANDSTONE LENSES
SILICEOUS LIMESTONE
MASSIVE GRAY SANDSTONE WITH CONGLOMERATIC LENSES NEAR THE TOP AND BOTTOM AND SHALE AND SANDY SHALE COMMON IN THE MIDDLE
Feet
300
200
100
0
Scale
M.M.J.

Figure 14. Columnar section of Mississippian and basal Pennsylvanian series.

The only complete exposure of the Loyalhanna is along the Western Maryland Railroad in the Youghiogheny gorge through Chestnut Ridge. Here 58 feet of typical Loyalhanna are exposed. The upper few feet show signs of silicification, but no thin sections are available to prove or disprove the indications. In some of the bluestone quarries nearly complete sections of the formation can be obtained. In the quarry of the Vang Construction Co., which is 600 feet vertically above the Youghiogheny on the north side of its gorge through Chestnut Ridge, 55 feet of Loyalhanna are exposed above the quarry floor, which is said to be at or near the top of the Pocono sandstone. Along Dunbar Creek in the quarry of the New Castle Lime & Stone Co., a thickness of 65 to 70 feet is exposed and some of the formation may lie below the quarry floor. East of Uniontown in the quarry of the Coolspring Bluestone Co., only 35 to 40 feet are exposed and it is fairly certain that the formation is thicker here as the quarry exposes neither the underlying Pocono nor the overlying Mauch Chunk.

Stevenson (1878, p. 53) reports that the Loyalhanna is only 4 feet thick near the West Virginia border, but observations by the writer in the Wymps Gap region have disclosed a minimum thickness of 25 feet and it is probable that the thickness is greater. Along Laurel Hill in the quarry of the Standard Lime & Stone Co., south of Youghiogheny River, the Loyalhanna is 50 feet thick. No other complete exposures of the formation were seen along this ridge, but many partial exposures indicate a general thickness of at least 30, and in some places 40 feet.

Areal distribution. Loyalhanna outcrops are limited to areas along the Laurel Hill and Chestnut Ridge anticlines. On Laurel Hill north of Youghiogheny River every stream draining west from the ridge crest has cut into the anticline, exposing the Loyalhanna. In the gorge of the river itself, the Loyalhanna is carried far above drainage by the anticline and outcrops around the base of Sugarloaf Knob. Southward the strata plunge steeply and the only outcrop is at drainage level of Beaver Creek near Beaver Creek School.

On Chestnut Ridge north of Route 711, Loyalhanna limestone barely appears above drainage along Mounts Run, but on Breakneck Run a considerable thickness of Pocono is exposed beneath it. It is shown on the map as cropping out on Green Lick Run, Butler Run and the unnamed stream south of Butler Run, where it was not observed, but where the general structure of the region shows that it should crop out. It crops out on both branches of Connell Run south of Route 711 where several quarries have been opened and one, the Opperman Bluestone Co., is now operating. In the gorge of Youghiogheny River through Chestnut Ridge the anticline carries the Loyalhanna far above drainage and it has been opened in several quarries all now abandoned except the Vang Construction Co. quarry and mine. An extensive outcrop extends along Dunbar Creek through Chestnut Ridge to the headwaters near Jumonville where a steep rise in the strata along the anticlinal axis splits the Loyalhanna outcrop into two parts which extend southward along the foot of the ridge and up the lower spurs on both sides as far as the triangulation station 5½ miles south of Summit. From this point south, the southward plunge of the anticlinal axis carries the Loyalhanna downward so that it appears first on the crest of the ridge and then passes below the overlying Mauch Chunk shales and Pottsville sandstone and crops out only where streams have breached the anticline.

Age and correlation. Although no fossils have ever previously been reported from the Loyalhanna limestone, the following were found during the present work:

Endothyranella sp.
Bairdia sp.
Bythocypris sp.
Zaphrentis spinulosa ? Edwards and Haine
Crinoid stems

The microfossils were found in an outcrop along the Western Maryland Railroad about 3 miles southeast of Connellsville. They come from the upper 5 feet of the formation. Charles Butts has tentatively identified a cup coral in the outcrop as *Zaphrentis spinulosa.* A thin section of the top of the Loyalhanna at the triangulation station 5½ miles south of Summit on Chestnut Ridge shows traces of ostracod shells which have been identified by R. S. Bassler as the Mississippian genus *Bairdia* and *Bythocypris.* Several thin sections from various parts of the county show traces of foraminifera, only one of which was identifiable. L. G. Henbest identifies it as an upper Mississippian species of the genus *Endothyranella.*

It is not possible to determine the age of the Loyalhanna from these fossils, but it without doubt is Mississippian and probably correlates with the Ste. Genevieve limestone of the Mississippi Valley as was determined by Butts (1924, p. 254).

The boundary between the Loyalhanna and the underlying Pocono sandstone was clearly seen in only one place, along the Western Maryland Railroad tracks in the Youghiogheny gorge through Chestnut Ridge. Here there is a definite line of demarcation between the two. The Loyalhanna above the line is very sandy but still retains its cross-bedded character and some of its calcitic cement. The Pocono below the line of demarcation is noncalcareous sandstone and is evenly bedded. There is no angular unconformity between the two, but there is a distinct break in the type of deposition as well as in the material deposited. Whether the break is sufficient to account for all the time between the postulated Burlington age of the top of the Pocono and the Ste. Genevieve age of the Loyalhanna cannot be said.

The fact that many of the earlier workers assumed that the Loyalhanna graded downward into the Pocono is understandable. The Loyalhanna becomes distinctly more sandy towards the base in many places and unless the exact contact between it and the Pocono was exposed well enough to show the change in the character of the deposition between the two the logical conclusion would be a gradational boundary.

MAUCH CHUNK SERIES

Character and thickness. The Mauch Chunk series in Fayette County is divided into three parts. The lower part, consisting of red and green shale and buff to olive micaceous sandstone, lies directly on the Loyalhanna. The middle part, consisting of dark fossiliferous limestone and interbedded gray shale, separates the upper and lower parts. The upper part consists predominantly of bright red shale with lesser amounts of green shale and buff micaceous sandstone.

The lower member is exposed in few places. The most complete section was obtained along the Western Maryland Railroad in the Youghiogheny Gap in Chestnut Ridge. The following section was measured:

	Feet	
Greenbrier	10	Limestone, dark fossiliferous
	15	Concealed (in part red shale)
	3	Sandstone, greenish
	1	Shale, gray
Lower shales	2	Sandstone, dark buff
	3	Shale, red
	1	Shale, green
	3	Shale, red
Loyalhanna	20+	Limestone, gray, siliceous

The extreme variability of the beds can be seen by comparing this section with a partial section taken nearby.

	Feet	
	3	Sandstone, dark buff
Lower shales	2	Shale, red
	1	Sandstone, gray micaceous
	3	Shale, red
Loyalhanna	50	Limestone, gray siliceous

Commonly there is some sandstone in the lower shale group, but it may be in the midst of the group as in the sections given above, or it may be at the base of the group as in the New Castle Lime & Stone Co. quarry on Dunbar Creek where 8 feet of hard, even-bedded sandstone lies directly on the Loyalhanna. Red shale overlies the sandstone. In the Wymps Gap region only red and green shale were seen between the Greenbrier and Loyalhanna limestones. The interval between the limestones is 15 feet along the road west from the gap, whereas a short distance east of the gap the two limestones are within 5 feet of each other. No good exposures of the lower shales were found on Laurel Hill.

The thickness of the lower shales of the Mauch Chunk series varies from 5 feet to more than 60 feet. The group is thinnest at the south end of Chestnut Ridge in the Wymps Gap area and thickens northward along Chestnut Ridge to 25 or 30 feet in the vicinity of Connellsville. On Laurel Hill the shales are considerably thicker, judged by the interval between the Greenbrier and Loyalhanna limestone outcrops. In the neighborhood of Beaver Creek School the Greenbrier limestone lies 40 feet above the Loyalhanna. This interval increases northward and the Greenbrier limestone was seen 60 feet or more above the Loyalhanna in the vicinity of Longwood school.

The Greenbrier is a dark blue-black, fossiliferous, massive bedded limestone. Interbedded dark gray calcareous shale near the top may form up to 50 percent of the strata. The limestone beds are composed of many small fossils and fossil fragments which are cemented together by finely crystalline calcite. One thin section showed a small number of very fine grains of quartz sand but in nearly all eases the only impurity seemed to be cryptocrystalline shaly fragments in the shell material, but in a few cases also in the cementing material.

The Greenbrier limestone varies in thickness from 5 to 40 feet. It is thinnest along the northern border of the county and thickens southwestward, reaching its maximum thickness in the Wymps Gap region. In the northeast corner of the county on Laurel Hill, 5 feet of Greenbrier is exposed in the George Pritts quarry (284). The limestone, which at this point contains no interbedded calcareous shale, is overlain and underlain by red shale. This exposure may be only part of the Greenbrier. At the Meade Mountain quarry (294), which is on the Mud Pike where it crosses Laurel Hill, there is 10 feet of massive limestone underlain by red sandy shale. In the Beaver Creek school region 13 feet of Greenbrier is exposed in the Ed. Hensel quarry (319). The following section was measured in this quarry:

Feet	
3	Limestone, black, massive
2	Shale, gray, calcareous
8	Limestone, blue-black, fossiliferous

It is believed this section does not represent the whole thickness of the Greenbrier in this region because incomplete sections in nearby exposures show total thicknesses ranging from 15 to 20 feet. In the vicinity of Freed on Chestnut Ridge the Greenbrier limestone crops out and has been opened in several quarries. It is about 9 feet thick in this region and has about one foot of calcareous shale near the top. East of Connellsville along Breakneck Run in the Sam Harshman quarry (70), 10 feet of massive fossiliferous limestone is exposed. A few feet of gray calcareous shale lies between the limestone and the overlying red shale. East of Uniontown along the National Pike the Greenbrier has been opened on both flanks of Chestnut Ridge. In the North Union Township quarry (220) on the west flank, the following section was measured:

Ft.	in.	
3	4	Red shale
3	0	Limestone, red and green shale
2	6	Gray limestone
1	6	Limestone and shale
1	6	Gray to greenish shale
9	0	Massive limestone
0	6	Thin limestone and gray shale
8	0	Massive limestone
		Concealed

At this quarry the Greenbrier has a thickness of at least 24 feet, whereas in the J. V. Thompson quarry (249) the thickness is about 29 feet and the section is as follows:

Ft.	in.	
3	6	Surface clay and green shale
1	8	Hard limestone
2	0	Greenish fossiliferous shale with thin limestone
4	0	Massive limestone
1	6	Dark shale
22	0	Massive limestone
0	6	Shaly limestone
		Concealed

In the Wymps Gap area the Lee Hunnel quarry (169) exposes 20 feet of massive dark fossiliferous limestone which is overlain by interbedded limestone and calcareous shale, the thickness of which could not be determined. West of the gap several exposures in stream gulleys on the hillside above the road show at least 30 feet of limestone and possibly 40 feet.

The upper member of the Mauch Chunk series consists primarily of red shale and sandy shale with some gray, micaceous sandstone and some green shale. Exposures of this member are very rare, as most of its outcrop is covered by float from the overlying Pottsville sandstone. The most complete section observed is exposed along the National Pike on the west flank of Chestnut Ridge.

Feet		
	Massive sandstone, Lower Connoquenessing	
½	Clay, white, uneven	
	Unconformity	15°
6	Shale, red	
4	Sandstone, buff, weak	
30	Shale, red and green	
40	Sandstone, fine-grained micaceous	
	Unconformity	10°
25	Shale, red	
15	Shale, buff, sandy	
25	Shale, red	
	Limestone and shale, Greenbrier	

This gives a total thickness for the upper member of 145 feet, which seems to be about the average in Fayette County. The thickness along the Youghiogheny River where it cuts the west flank of Chestnut Ridge is approximately 100 feet, although the incompleteness of the section makes it difficult to get an accurate measurement. No other complete sections of this member are exposed in the county and the best estimates of the thickness must be made by taking the interval between the base of the Pottsville and the Greenbrier limestone. In areas where the dip of the strata is nearly horizontal such measurements are highly accurate and measurements by this means show the thickness of this member to range from 100 to 175 feet and commonly to be between 130 and 150 feet.

Areal distribution. The surface exposures of the Mauch Chunk series are confined to Laurel Hill and Chestnut Ridge. The outcrops on Laurel Hill are arranged in two parallel bands, one on each side of the shallow central valley running along the crest of the hill. In the northern part of the ridge the bands are joined across the ridges between the drainage basins in the central valley, but south of Clay Run school the bands become straighter than they are to the north and gradually diverge to the gorge of the Youghiogheny, where they are about 5 miles apart. South of the gorge they join, forming an arc around Sugarloaf Knob, which also carries an isolated outcrop of the Mauch Chunk. Southward from here there is only one more area of Mauch Chunk outcrop along the ridge. It occurs where Beaver Creek has breached the anticlinal axis north of the National Pike.

On Chestnut Ridge north of the Youghiogheny gorge the Mauch Chunk series is exposed only on the western flank where all the streams have breached the anticline sufficiently to expose these strata. Southward from the gorge the outcrops become irregular, sinuous lines following the valleys of most of the streams draining the ridge as far south as Jumonville, where the outcrop divides into two bands, one of which follows each flank of the ridge southward. In the Wymps Gap area, at the southern extremity of the ridge in Fayette County, the Mauch Chunk crops out nearly on top of the ridge and in the stream valleys which there breach the center of the anticline.

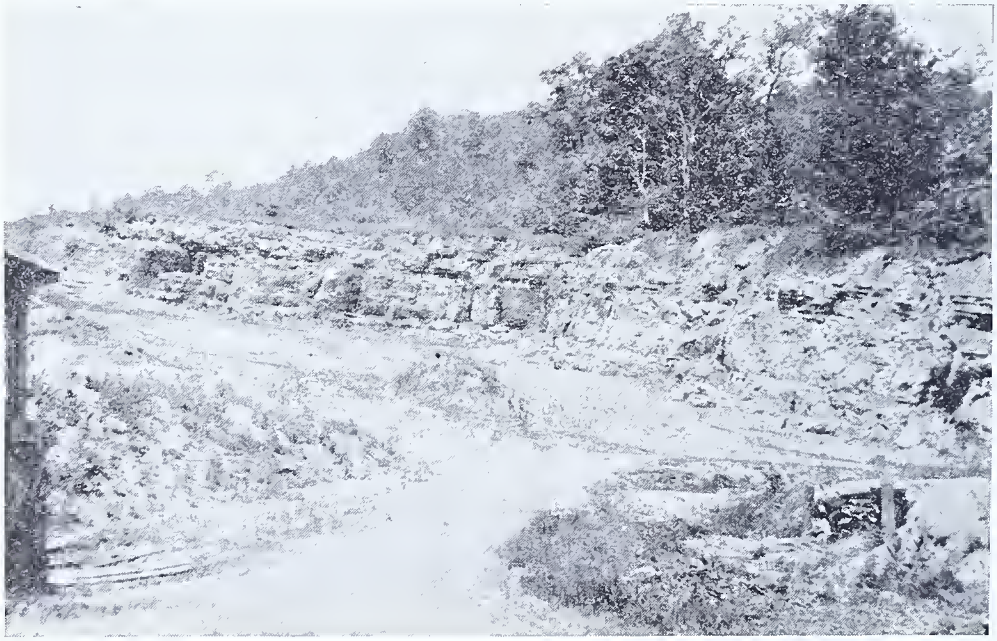

Figure 15. Greenbrier limestone quarry on U. S. Route 40.
Fossil shells are abundant in this quarry at the east foot of Chestnut Ridge.

Age and correlation. The age of the Mauch Chunk is not well known, but is commonly thought to be Chester. Except for the Greenbrier limestone member, it is nonfossiliferous. Fossils are abundant in the Greenbrier, but they have never been thoroughly studied in Pennsylvania. The best fossil collecting area in the county is in the J. V. Thompson quarry (249) on the National Pike at the foot of the east flank of Chestnut Ridge. Miss Frances Benson,[10] who studied the brachiopods found in this quarry, states that they are either Ste. Genevieve or Chester in age, but that a more specific determination of the age of the limestone will have to wait until some of the other phyla are studied, as all the brachiopods are long-lived forms.

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[10] Benson, Frances M., The Brachiopods of the Greenbrier limestone near Uniontown, Penna.: Penna. Acad. Sci., vol. VIII, p. 62, 1934.

PENNSYLVANIAN SYSTEM

The Pennsylvania system comprises all the beds lying above the red Mississippian, Mauch Chunk strata and below the base of the Permian which is taken as the top of the Waynesburg coal in southwestern Pennsylvania. The system is divided into the Pottsville series at the base, the Allegheny group, the Conemaugh group, and the Monongahela group at the top. The Pottsville series is a separate lithologic unit differing considerably from the overlying groups which are artificial, not natural divisions, having been separated from each other for economic purposes on the basis of the coals they contain.

POTTSVILLE SERIES

General account. The Pottsville series is largely composed of sandstone and sandy shale, but contains a few thin beds of coal and fire clay just above the middle. In Fayette County it may be divided into five parts, the three lowest of which are often indistinguishable because the middle one of the three is thin or wanting in many places. Enumerated from the base upwards they are: Lower Connoquenessing sandstone, Quakertown coal and shale, Upper Connoquenessing sandstone, Mercer formation and Homewood sandstone. The Sharon coal and sandstone which are present below the Connoquenessing in the regions north and south of Fayette County appear to be absent within the county.

A generalized section for Fayette County is given below which records the average thickness and variation of the members of the series.

Generalized section of the Pottsville series.

	Average thickness (feet)	Variation (feet)	
Clay or clay shale			Allegheny
Sandstone, thick-bedded, weak	15	10–25	Homewood
Sandstone, massive, conglomeratic	35	20–50	
Coal (Tionesta)	0	0–½	Mercer group
Shale, buff	4	0–10	
Coal (Upper Mercer)	2	1–4	
Fire clay (Mt. Savage)	3	2–6	
Shale with iron ore	20	10–25	
Coal (Lower Mercer)	1	1–2	
Shale with iron ore	15	10–20	
Sandstone, massive to weak shaly	50	40–55	Upper Connoquenessing
Coal, shale, and carbonaceous shale	5	0–20	Quakertown
Sandstone, massive to weak	50	40–60	Lower Connoquenessing
Unconformity			
Red shale			Mauch Chunk

Areal distribution. The Pottsville series crops out abundantly in eastern Fayette County, but at only two places west of the Chestnut Ridge anticline. Along the Laurel Hill anticline the Pottsville crops out on both sides of the axis. A discontinuous belt of nearly flat-lying sandstone occurs along the eastern boundary of the county from the Westmoreland County line nearly to the Youghiogheny River. A parallel band 2 to 3 miles west of the first crops out along the western flank of the ridge where the strata have a steep dip. South of the Youghiogheny River the two bands of Pottsville extend as far south as the National Pike and join north of Beaver Creek School and at Pike School, where the arch of the anticline is not sufficient to carry the sandstone above the top of Laurel Hill. In the Ohiopyle Valley the Youghiogheny River has exposed the Pottsville throughout its course and several of the small tributary streams have cut through the Allegheny and are trenching the Homewood sandstone.

On Chestnut Ridge, north of the Youghiogheny River, the Pottsville sandstones form the cap rock of the ridge and in many places extend down the spurs on the western flank of the ridge to encircle outcrops of underlying strata which lie along the streams between the spurs. Although the Pottsville caps the ridge immediately south of the river, the rise of the anticlinal axis south of Paul Flats brings the underlying strata to the surface along the ridge crest and the Pottsville crops out in two bands along the foot of both flanks of the ridge as far south as the West Virginia boundary. At the boundary, the Pottsville again caps the ridge on Devies Mountain and the crests north and south of Wymps Gap.

Along the Fayette anticline the structure brings the Pottsville high enough to crop out in two places along the Youghiogheny River southeast of Layton and along Jacobs Creek west of Tyrone Mills.

Lower Connoquenessing sandstone. There are few places in Fayette County where this part of the Connoquenessing sandstone is exposed. The outcrops are mostly on the slopes of Chestnut Ridge and Laurel Hill. Talus from the overlying sandstones commonly covers this stratum. Where seen, however, it is a gray, heavy-bedded to massive sandstone, in places iron-stained. Cross bedding is not conspicuous and mica is commonly associated with the bedding planes. However, this sandstone is less conspicuously micaceous than those of the Mauch Chunk, but in some respects resembles them. It is partially replaced by sandy shale in some areas. The best exposure occurs along the National Pike west of Chestnut Ridge. (See Fig. 16.) Massive sandstone 35 feet thick is overlain by five feet of interbedded sandstone and shale. In this exposure the sandstone is separated by 6 inches of white clay from the Mauch Chunk shale which it overlies with an angular unconformity of 15°.

Quakertown coal and shale. The Quakertown coal which separates the Upper and Lower Connoquenessing sandstones is nearly always associated with, or replaced by, a gnarly black carbonaceous shale. The coal itself is thin and of low quality; it commonly occurs in lenses in the black shale and is not a continuous bed. The best exposures of the coal are in the quarries and mines of the Dunbar Corporation

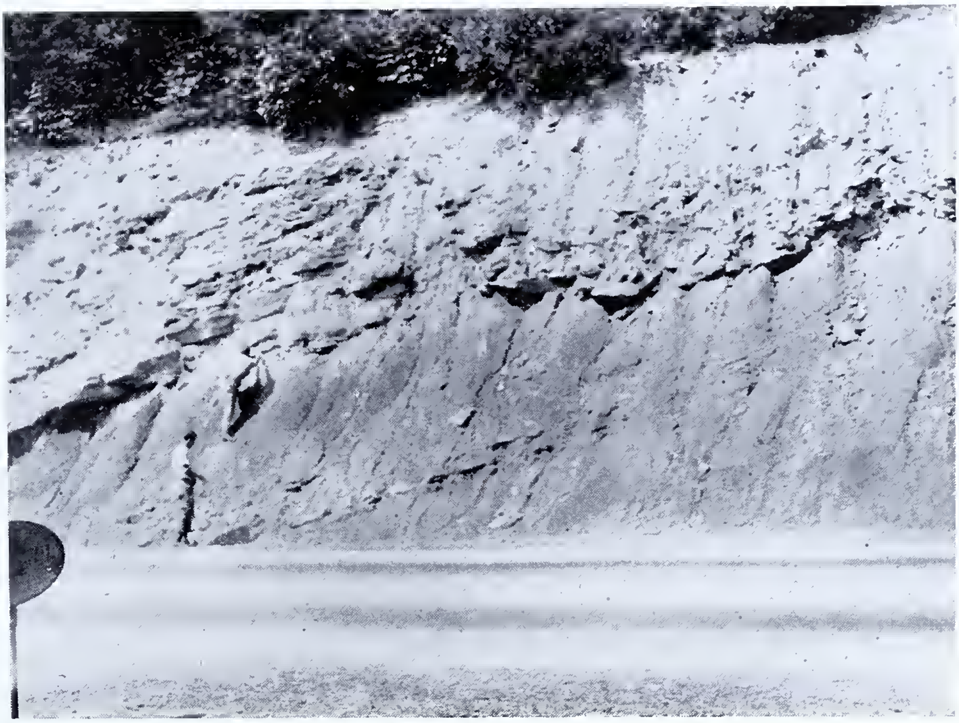

Figure 16. Unconformity at base of Connoquenessing sandstone.
Mauch Chunk red shale below. U. S. Route 40, ¾ mile east of Hopwood.

southeast of Dunbar borough. Here the shale and coal are irregular, thickening to 15 feet in places and thinning again or entirely disappearing within a few feet. Both the floor and roof are irregular and the bed itself does not maintain a constant horizon over any great distance. The character and behavior of the coal indicate an origin by accumulation of woody debris washed into its present position rather than accumulation in the place of growth. The bed is of no commercial importance and is useful where it can be found only as a means of separating the Upper and Lower Connoquenessing sandstones.

Upper Connoquenessing sandstone. Although less persistent than the Lower Connoquenessing sandstone, the Upper is more abundantly exposed in Fayette County. In places it has been replaced by clay-shale and sandy shale, but it commonly consists of heavy-bedded to massive gray sandstone which is predominantly composed of medium to coarse, rounded quartz grains. Cross bedding is not evident in most places. Fresh material is commonly a nearly uniform gray and may contain carbonized plant remains and clay chips. When weathered, however, many of the outcrops are brownish from limonite staining which has developed during weathering. The best exposure of this member is in the mine and quarries of the Dunbar Corporation. However, in this area the sandstone is not typical of the formation, being nearly white, very massive and of higher quality than elsewhere in the county. Another good exposure which is more typical of the formation can be seen at intervals along the banks of the Youghiogheny River for some miles below the Ohiopyle Falls. Here the sandstone is heavy-bedded, gray and somewhat finer-grained than at Dunbar. Other outcrops in stream gorges on Chestnut Ridge and Laurel Hill and much float at various places along the outcrop show the character to be similar to the rock along the Youghiogheny River. In the section along the National Pike on the west flank of Chestnut Ridge the interval commonly occupied by the sandstone consists almost entirely of shaly material. Likewise, many of the well records from the western part of the county fail to show sandstone in the interval commonly occupied by the Upper Connoquenessing beds.

Mercer group. Lying above the Connoquenessing and below the Homewood sandstones the Mercer group is seldom seen in natural exposure or road cuts. Sections have been obtained at several places, the best of which are at Cucumber Falls near Ohiopyle, on the west flank of Chestnut Ridge along the Fayette-Westmoreland County line, and in a diamond drill hole on the George Kern farm, 1 mile south of Normalville.

Mercer section at Cucumber Falls

Feet		
30–35	Sandstone, massive	(Homewood)
0–1	Coal	(Tionesta)
2	Shale, brown	
2	Slate, blocky	
10	Sandstone, brownish and clay shale	
2½	Coal	(Upper Mercer)
3	Fire clay, plastic	(Mercer)
1	Sandstone	
5	Clay shale, gray	
	Concealed	

Mercer section on Chestnut Ridge along Fayette-Westmoreland County boundary

Feet		
35+	Sandstone, heavy-bedded to massive, pebbly white	(Homewood)
0–2	Shale, black	
½	Coal, bony	(Tionesta)
2	Clay shale	
15	Concealed	
3	Coal	(Upper Mercer)
5	Clay, plastic	(Mercer)
10	Sandstone, medium-bedded, brownish	
1	Coal	(Lower Mercer)
5	Clay and shale	
40	Sandstone, brownish, massive	(Upper Connoquenessing)
	Concealed	

Mercer section from diamond drill hole on George Kern farm, 1 mile south of Normalville

Ft.	in.			
			Dark gray shale	(Allegheny group)
45			Hard sandstone	(Homewood)
0	8	Coal	Coal and slate	(Upper Mercer)
0	5	Slate		
1	8	Coal		
3			Fire clay	(Upper Mercer)
1	9		Dark gray shale	
0	8		Black slate	
	10		Coal	(Lower Mercer)
2			Fire clay	(Lower Mercer)
17			Sandy shale	
25+			Soft sandstone	(Upper Connoquenessing)
			End of hole	

There are three coal beds in the Mercer group but the upper and lower are thin and poor. The middle bed (Upper Mercer) is fair to good coal, however, and has been opened at several country banks. The base of the Homewood sandstone has in many places transgressed downward, cutting out all, or nearly all, the strata above the Upper Mercer coal. The outcrop at Cucumber Falls is extensive enough for this transgression to be observed. Iron-carbonate nodules and lenses which weather to limonite are abundant in the shales above and below the Upper Mercer coal and have been mined in a few places. Stevenson (1877, p. 195) gives a section, not visible at present, of such iron ore beds.

Section on Mounts Creek near Vernon Furnace

Ft.	in.		
	4	Ore	
15		Concealed	
60		Pottsville conglomerate	(Homewood)
3	6	Coal bed	(Upper Mercer)
3		Sandstone	
1		Clay	
	3	Pin ore bed	
2	6	Clay	
1	2	Big bottom ore bed	
3		Clay	
	2	Ore	
		Concealed	

Stevenson considered the 60 feet of sandstone to be the whole Pottsville and includes the strata below it in the Mauch Chunk (Umbral). This, however, is not the case. The sandstone is clearly only the Homewood, and the underlying strata are the upper part of the Mercer group, the coal being the Upper Mercer seam.

Correlation of the Mercer group must be made by means of stratigraphic position and lithology since the Mercer limestones with their accompanying fossils were not found in Fayette County. However, the lithologic similarity is so great between the Fayette sections and nearby sections where fossils are present that there is little room to doubt the equivalence.

Homewood sandstone. The Homewood sandstone forms prominent outcrops along Chestnut Ridge and Laurel Hill as well as in the Youghiogheny gorge where it crosses the Ohiopyle Valley. The sandstone is massive, hard, and light-colored to white. The upper part is commonly thick-bedded, and the lower part is extremely massive and in many places crops out as a single bed 20 to 30 feet thick. The sandstone is the purest of any in Fayette County and at Dunbar has been mined for glass manufacture for many years. The sandstone is composed almost entirely of subangular quartz grains cemented by quartz. Small amounts of a black opaque mineral, probably magnetite or some other iron mineral, and a micaceous mineral which has the appearance of green biotite are present, but combined are scarcely more than one percent of the rock. In places clay balls and plant remains are numerous in the upper part of the Homewood. Both Sigillaria and Lepidodendron tree trunk impressions are found. They are especcially abundant in the sandstone outcropping along the banks and in the bed of the Youghiogheny above Ohiopyle Falls.

The two-fold division of the Homewood sandstone is a common feature and may be considered diagnostic of the formation, especially where it crops out along the slopes of Chestnut Ridge. The upper part ranges in thickness from 5 to 30 feet, but is commonly only 15 to 20 feet thick. Its outcrops are not numerous because of the slumping of the overlying shales and clays and because it has commonly been removed from the many hilltops which are capped by the underlying massive layer. Evidence of the presence of these beds in most places is float from them which is found lying above the cliffs formed by the

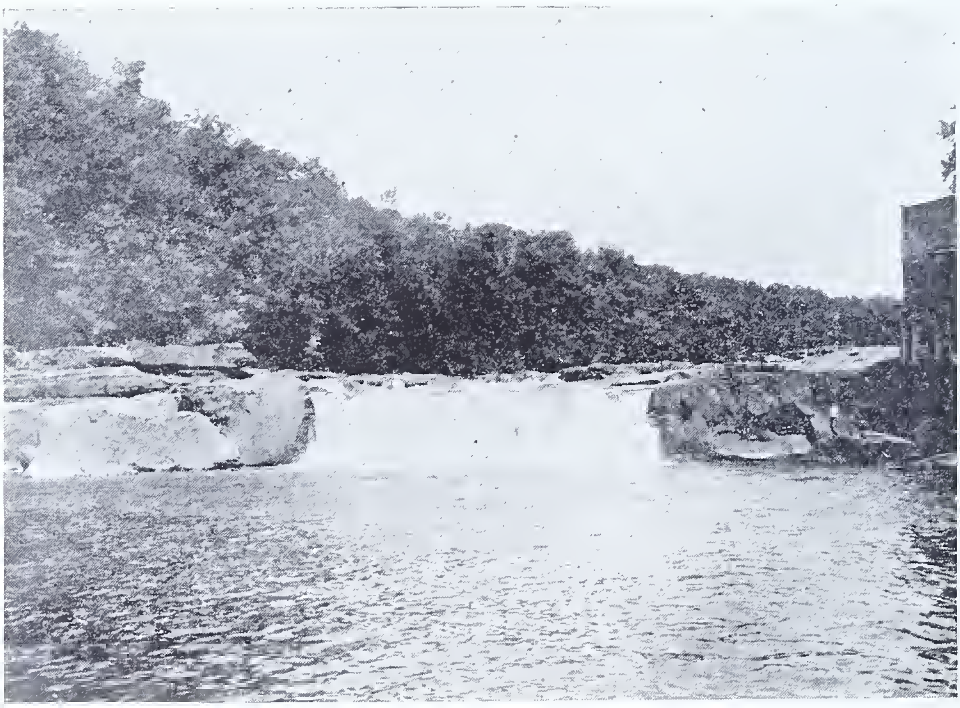

Figure 17. Homewood sandstone at Ohiopyle Falls in Youghiogheny River.

massive underlying bed. The bedding planes of the Upper Homewood are irregular but do not show cross-bedding, although ripple marks have been observed in a few places.

The lower part of the Homewood is composed of a single massive sandstone bed 20 to 50 feet thick(see Fig. 17). Outcrops are abundant and on the steep flanks of Laurel Hill and Chestnut Ridge it forms cliffs on nearly all the prominent spurs. These cliffs are particularly prominent on the west flank of Chestnut Ridge south of the National Pike. Here 40- and 50-foot cliffs have been observed on the sides of some of the spurs. Great blocks break away from the cliff faces and work their way down the steep slopes. These blocks are commonly the entire thickness of the bed and may be 20 by 40 feet in their other dimensions. Their size and shape is controlled by a system of joints which has been developed in this massive bed of sandstone probably at the time of the folding that produced the major anticlines and synclines of the region. Close observation of a weathered surface of this massive bed shows that the structure is not homogeneous. Unequal cementation of some of the small beds has caused the softer ones to be etched by weathering, leaving the harder standing out as ridges on the cliff faces. By this means it can be seen that this 20- 40-foot bed of sandstone is composed of many thinner beds of fairly uniform thickness which in turn contain great numbers of minute bedding planes inclined at steep angles to the beds themselves and to the great massive bed.

In the drill records from the western part of the county the Homewood sandstone does not show up as the striking feature that it presents in the eastern part of the county. This may be because the driller records as sandstone anything from sandy shale to massive conglomerate. However, there are a few places where it is probable that the Homewood sandstone may actually be lacking and that the drillers are correct in their failure to record the presence of a sandstone at the horizon that should be occupied by the Homewood.

ALLEGHENY GROUP

General account. The Allegheny group is the lowest part of the "Coal Measures" and was formerly called the Lower Productive Measures. The name Allegheny comes from the Allegheny River, where these rocks are well exposed north of Pittsburgh. The group consists of shale and sandstone with lesser amounts of coal, fire clay and limestone. The base is at the top of the Homewood sandstone and the top at the top of the Upper Freeport coal, above which lies the Conemaugh group. The group has been subdivided into three parts on the basis of the coals it contains. These are called Freeport, Kittanning and Clarion members. In this report, however, the group will be treated as a whole and has been mapped as a unit. Many of the individual beds have been named because of their economic importance or their prominence in the field and they will be discussed below individually.

The thickness of the Allegheny formation ranges from 140 to 230 feet. It is much thinner along the western flank of Chestnut Ridge than on the Fayette anticline and in the Ohiopyle Valley. Two generalized sections are presented below, one of which is referable to Chestnut Ridge and the other to the rest of the county. The thickness of the Allegheny on the Laurel Hill anticline was not determinable.

Generalized section of the Allegheny group.

Name and character of strata		Variation in thickness (feet)	Average distance to top of Upper Freeport coal	
			Chestnut Ridge	Elsewhere
Uffington shale (Conemaugh)				
Upper Freeport	coal	3– 6		
" "	fire clay	3–10		
" "	limestone	0– 5	12	11
Bolivar	fire clay	0–10		15–20
Butler	sandstone	5–15		
Lower Freeport	coal	0– 3	50	55
" "	fire clay	3– 8	55	60
" "	limestone	0– 2		
Freeport	sandstone	10–30		
Upper Kittanning	coal	0– 3		
Johnstown	limestone	0–10		
Upper Westernport	sandstone	10–40		
Middle Kittanning	coal	0– 1		120
Lower Westernport	sandstone	5–30		
Lower Kittanning	coal	2– 5	100	140
" "	fire clay	3– 6		
Kittanning (Clarion)	sandstone	10–20	115	160
Vanport	limestone	0		
Clarion	coal	0– 1		170
"	clay	2– 8		
Brookville	coal	2– 7	145	200
"	clay	5–15		
Top of Homewood sandstone (Pottsville)			155	215

In the above generalized section it can be seen that the greater part of the thinning of the Allegheny group along Chestnut Ridge in respect to the rest of the county has taken place in the Kittanning member between the Lower Freeport and the Lower Kittanning coals. In the section along the National Pike where it crosses Chestnut Ridge a 4- to 6-inch coal is exposed 20 feet above the Lower Kittanning coal. If this is the Middle Kittanning coal, it shows that the thinning of the Allegheny has taken place largely in the interval between the Lower Freeport and Middle Kittanning coals.

Areal distribution. The Allegheny group crops out in all parts of Fayette County except the extreme western edge. However, outcrops are very scarce west of Chestnut Ridge. Along the Fayette anticline the Allegheny group is brought high enough to be exposed only where the Youghiogheny River and Jacobs Creek have cut steep-sided valleys across the anticline east of Layton and west of Tyrone Mills. A band of Allegheny rocks extends along the western flank of Chestnut Ridge from the Fayette-Westmoreland County boundary to the West Virginia State line. East of South Connellsville this band rises well up onto Chestnut Ridge, but in most other places it lies along the foot of the ridge. The Allegheny group crops out extensively in the Ohiopyle Valley. From Ohiopyle north to Westmoreland County, Allegheny rocks are exposed along the streams and up the hillsides. Only the tops of the higher hills are composed of Conemaugh strata. Allegheny rocks in this area rise well up on the gently sloping eastern flank of Chestnut Ridge, and at Paul Flats and along and north of the Springfield Pike, these rocks cap the highest hilltops. South of Ohiopyle, the Ohiopyle Valley is largely underlain by the Conemaugh and only the upper part of the Allegheny crops out along the courses of the larger streams. Bands of Allegheny are also found along the foot of the slopes of Chestnut Ridge and Laurel Hill. Allegheny strata also crop out along Laurel Hill from the West Virginia State line to the Pike school on the National Pike, and thence along the east flank of the hill northeastward to the Youghiogheny River at Huston. In the Johnstown syncline the Freeport coal crops just above drainage along the Youghiogheny River in several places near Somerfield.

Measured sections of the Allegheny. Recent railroad and highway cuts in Fayette County have exposed several good Allegheny sections which are given below. Much diamond drilling has been undertaken in the Ohiopyle Valley in the exploration and development of the coal of that region. A few selected drill records will be included and additional detail can be obtained in the chapter on coal in Part II of this report.

Upper Allegheny section, eastern flank of Fayette anticline on Jacobs Creek

Feet		
20+	Massive sandstone	(Lower Mahoning)
3⅓	Coal	(Upper Freeport)
4	Fire clay	" "
3	Nodular iron ore in shale	
25	Sandstone and shale	
15	Massive sandstone	(Butler)
2	Coal	(Lower Freeport)
2½	Clay	
½	Coal and bone	
3½	Rooty clay	
3	Sandy clay	
	Concealed	

Allegheny section, western flank of Fayette anticline on Jacobs Creek

Thickness		Character of beds		Distance from Upper Freeport coal
Ft.	in.			Feet
1	2	Coal	(Mahoning)	+20
2		White clay		
15		Massive sandstone	“	
1	8	Coal	(Upper Freeport)	0
2		Dark plastic clay	“ “	
1		Limestone (fresh water)	“ “	
2		Dark plastic clay	“ “	
1		Iron ore (carbonate)		
5		Plastic fire clay	(Bolivar ?)	
10		Sandstone	(Butler)	
3		Black clay shale		
2		Nodular shale and iron ore		
10		Olive shale		
36		Cross-bedded shale with sandstone layers		
1	6	Coal	(Lower Freeport)	73
3		Plastic clay	“ “	
1		Limestone (fresh water)	“ “	
6		Clay and shale		
20		Light laminated shale with iron ore balls		
3	6	Clay shale		
1	10	Coal	(Upper Kittanning)	108
2		Fire clay		
3		Clay with iron ore balls		
12		White sandstone	(Westernport)	
5		Clay		
3		Clay with ore balls		
15		Laminated shale		
2	7	Coal	(Lower Kittanning)	155
6		Dark rooty clay		
8		White sandy clay		
20		Massive light sandstone	(Kittanning-Clarion)	
1	3	Coal	(Clarion)	
5		Fire clay	“	
15		Brown shale		
1	3	Coal	(Brookville)	210
6		Dark shale		
6		Shale		
6		Soft sandstone	(Homewood)	222
15+		Massive sandstone	“	

The above section is typical of the Allegheny group in Fayette County except along the Chestnut Ridge anticline. It is the only complete section exposed west of the anticline but that its total thickness represents the group is borne out elsewhere, especially on the south bank of the Youghiogheny River at the Childs plant of the General Refractories Company. Here the strata are nearly horizontal and the Upper Freeport coal has been opened 220 feet above the top of the Homewood sandstone which is being mined for silica brick.

Allegheny section, west flank of Chestnut Ridge along Western Maryland Railroad

Thickness				Distance below Upper Freeport coal
Ft.	in.	Character of beds		Feet
		Sandstone	(Lower Mahoning)	
3		Coal (Hurds old mine)	(Upper Freeport)	
		Nodular clay	" "	
2		Limestone	" "	10
4		Nodular clay		
15		Gray shale		
12		Shale		
4		Sandstone and shale		
½		Coal		
1		Shale		
2		Coal	(Lower Freeport)	50½
2		Shale		
3		Yellow limestone	" "	55
6		Concealed		
10		Gray shale		
1		Sandstone		
18		Concealed		
12		Dark shale		
1		Coal	(Lower Kittanning)	103
4		Clay	" "	
5		Sandstone	(Kittanning)	
34		Concealed		
5		Shale and fire clay	(Brookville)	
37		Sandstone	(Homewood)	151

Allegheny section, west flank Chestnut Ridge along National Pike

Thickness				Distance below Upper Freeport coal
Ft.	in.	Character of beds		Feet
30		Hard gray sandstone	(Lower Mahoning)	
	6	Clay		
2	3	Coal	(Upper Freeport)	
	3	Clay		
1	3	Coal	" "	
3		Clay		
45		Concealed		
25		Massive sandstone	(Westernport)	
3	6	Shale		
1		Coal	(Middle Kittanning)	81
18		Brown shale		
	6+	Coal	(Lower Kittanning)	100
7		Concealed		
15		Shale and sandstone		
23		Massive sandstone	(Clarion)	
	6	Clay		
2	6	Coal	(Brookville)	
2		Bone and cannel coal	"	
3		Coal	"	154
3		Clay		
7		Concealed		
		Massive sandstone	(Homewood)	

Allegheny section, west flank of Chestnut Ridge near Springhill Furnace

Measured by J. S. Stevenson (1877, p. 141)

Thickness Ft.	in.	Character of beds		Distance below top of Upper Freeport coal Ft.	in.
		Sandstone	(Lower Mahoning)		
16	3	Coal and binders	(Upper Freeport)		
6		Fire clay	" "		
4		Limestone	" "		
10		Concealed			
4		Sandstone	(Butler)		
8		Shale			
4		Coal and binders	(Lower Freeport)	53	
2		Fire clay	" "		
2	6	Iron ore	" "		
26		Concealed			
4		Coal		87	6
1		Clay			
2	6	Limestone	(Johnstown ?)		
10		Concealed			
3		Sandstone	(Westernport)		
6		Fire clay			
1	8	Coal	(Lower Kittanning)	111	6
10		Sandstone	(Kittanning)		
25		Shale with iron ore nodules			
7	3	Coal	(Brookville)	153	
		Concealed			

It is obvious from the three sections given above that the Allegheny group is thinner along the western flank of Chestnut Ridge than along the Fayette anticline. Very incomplete sections on the west flank of Chestnut Ridge at Springfield Pike and the Westmoreland-Fayette County boundary, although they are too incomplete to publish here, give similar total thicknesses for the Allegheny.

Allegheny section on road 1½ miles north of Ohiopyle

Thickness Ft.	in.	Character of beds		Distance below top of Upper Freeport coal Feet
14+		Hard sandstone	(Lower Mahoning)	
3	6	Coal	(Upper Freeport)	
2		Fire clay		
2		Sandy shale		
3		Fire clay		
6		Sandy clay shale		
4		Hard sandstone	(Butler)	
6		Weak sandstone	"	
35		Concealed		
1		Coal	(Lower Freeport)	62
2		Fire clay		
2		Light gray shale		
25		Hard, gray, micaceous sandstone	(Freeport)	
	6	Black shale		
	6	Coal	(Upper Kittanning)	92
3		Fire clay		
6		Gray and yellow shale		
12		Thin-bedded, hard, gray sandstone	(Upper Westernport)	
2		Black shale		
2		Sandy shale		
	3	Coal		
	9	Flint fire clay	(Middle Kittanning)	117
3		Plastic fire clay		
6		Sandstone	(Lower Westernport)	
6		Gray shale		
6		Black shale		
2		Bone		
2		Coal	(Lower Kittanning)	143
4		Fire clay		
3		Sandy clay		
5		Sandstone	(Kittanning (Clarion))	
2		Light gray shale		
1		Carbonaceous shale	(Clarion coal?)	158
3		Fire clay and shale	(Clarion)	
12		Concealed		
2		Thin-bedded sandstone		
8		Dark gray shale		
5		Gray shale		
5		Coal and binder	(Brookville)	193
3		Fire clay		
4		Concealed		
10		Plastic clay		
		Sandstone	(Homewood)	210

Allegheny section on road at Cucumber Falls, Ohiopyle

Thickness Ft.	in.	Character of beds		Distance below top of Upper Freeport coal Feet
		Massive sandstone	(Mahoning)	
3		Shale	(Uffington)	
4		Coal and clay	(Upper Freeport)	
3		Clay	" "	
5		Sandy shale		
15		Sandstone, soft	(Butler)	
10		Shale with flint clay balls	(Bolivar)	
18		Shale, sandstone and concealed		
	6	Coal	(Lower Freeport)	56
3	6	Clay		
20		Sandy clay shale with iron ore		
11		Shale		
2	6	Coal	(Upper Kittanning)	92
1		Clay		
17		Soft sandstone	(Upper Westernport)	
6		Hard sandstone	" "	
22		Concealed with shale and sandstone		
1		Coal bloom	(Middle Kittanning)	139
10		Hard sandstone	(Lower Westernport	
10		Sandy clay shale		
2		Coal and binder	(Lower Kittanning)	161
4		Flint and plastic clay	" "	
14		Shale with iron ore		
15		Shale		
3		Coal	(Clarion or Brookville)	197
5		Concealed		
5		Clay		
15		Clay shale		230?
		Concealed, top of Homewood is not visible, sandstone float comes in shortly below end of section		

The Cucumber Run section has been measured at the same place by I. C. White (1891, p. 116) and J. J. Stevenson (1878, p. 89) and M. R. Campbell (1902, p. 8), all of whom have recorded total thicknesses greater than 260 feet. The section given above and measured by the writer gives an Allegheny thickness of only 230 feet. When the large concealed intervals in the old sections are considered, this difference is not remarkable, and the detailed section given herewith was obtainable only because a new road has an excellent exposure of nearly the whole Allegheny group.

No complete sections of the Allegheny are obtainable in the northern part of the Ohiopyle Valley, but numerous diamond drill holes have cut the strata above the Lower Kittanning coal and a few of the best are given below.

Allegheny section from diamond drill hole on Martin Minor farm ¼ mile northeast of Whites Bridge

Thickness Ft.	in.	Character of beds		Distance below top of Upper Freeport coal Ft.	in.
		Sandstone	(Lower Mahoning)		
5	6	Shale, dark gray	(Uffington)		
1	10	Coal	(Upper Freeport)		
0	6	Bony coal	" "		
4	6	Fire clay			
28	6	Light shale			
17	6	Sandy shale			
	6	Dark gray slate			
2	10	Coal	(Lower Freeport ?)	57	10
0	1	Slate			
1	4	Coal			
0	1½	Gray slate			
0	7½	Coal			
0	2	Bony coal			
1	8	Fire clay			
6		Gray slate			
	6	Bony coal	(Upper Kittanning ?)	66	0
6	9	Dark gray slate			
60		Sandstone	(Westernport)		
10	6	Light shale			
10	6	Dark gray shale			
0	10	Bony			
2	9	Coal	(Lower Kittanning)	157	4
	6	Dark gray shale			
4	6	Fire clay			
		Concealed			

Allegheny section from diamond drill hole on George Kern farm ½ mile south of Normalville

Thickness		Character of beds		Distance below top of Upper Freeport coal (Estimated)	
Ft.	in.			Ft.	in.
25		Surface			
6		Light shale			
5		Sandstone	(Butler)		
5		Dark gray slate			
1	3	Black slate and coal			
0	7	Coal	(Lower Freeport)	60	0
4	6	Fire clay	" "		
17	6	Dark gray shale			
	6	Coal	(Upper Kittanning)	82	6
2	6	Fire clay			
3		Light shale			
14		Sandstone	(Upper Westernport)		
4	2	Dark gray shale			
7		Impure limestone	(Johnstown)	113	3
13	4	Light shale			
8	10	Dark gray shale			
	9	Coal	(Middle Kittanning)	136	1
9	7	Dark sandy shale			
9	4	Dark gray shale			
0	4	Bony coal			
2		Coal	(Lower Kittanning)	157	4
12		Fire clay and shale			
14	10	Variegated shale			
4		Dark sandy shale			
6		Dark gray shale			
45		Hard sandstone	(Homewood top)	194	2

The upper part of the Allegheny group has been eroded at this point and the interval between the Upper and Lower Freeport coals has been estimated as 60 feet, which is a good average for the Normalville area. This gives a total Allegheny thickness of only 193 feet, which is below the average, but the missing thickness is below the Lower Kittanning coal and not in the upper part of the section. The lack of Clarion and Brookville coals from the section is purely local as surface outcrops in the immediate vicinity show the Brookville coal cropping out about 10 feet above the top of the Homewood sandstone.

Allegheny section, diamond drill hole on William Beal farm ¾ mile north of Davistown

Thickness Ft.	Thickness in.	Character of beds		Distance below top of Upper Freeport coal Ft.	Distance below top of Upper Freeport coal in.
17		Surface			
2		Coal smut	(Upper Freeport)		
4		Soft clay			
8		Fire clay	" "		
2	8	Shale and limestone	" "		
20	6	Sandstone, shale streaked	(Butler)		
3	2	Sandstone			
13		Shale with fire clay			
3		Limestone	(Lower Freeport)		
8		Fire clay			
13	5	Sandstone	(Freeport)		
1	6	Dark slate			
0	2	Coal	(Upper Kittanning)	81	7
0	4	Slate			
1	7	Coal			
5		Dark slate			
6		Fire clay			
47	6	Sandstone	(Westernport)		
2	3	Dark slate			
24		Dark sandy shale			
8	5	Dark slate			
0	3	Coal	(Lower Kittanning)	179	3
0	3	Slate			
4	0	Coal			
5	7	Fire clay	" "		
3	5	Sandstone			
0	8	Fire clay			
10	3	Sandstone	(Kittanning (Clarion))		
3	9	Dark slate			
1	10	Carbonaceous slate	(Clarion coal)	204	9
12	2	Dark slate			
0	1	Coal	(Brookville)	217	0
3	5	Fire clay			
6	3	Dark slate			
		End of hole			

Allegheny section, diamond drill hole on George Wadsworth farm 1½ miles northwest of Roaring Run on county boundary

Thickness Ft.	in.	Character of beds		Distance below top of Upper Freeport coal Ft.	in.
		Sandstone	(Mahoning)		
4	0	Dark gray slate	(Uffington)		
5	0	Black slate			
1	7	Coal	(Upper Freeport)		
0	3	Black slate			
0	10	Impure fire clay			
0	5	Bony coal			
5		Fire clay	" "		
10		Sandstone and shale			
15	4	Light gray shale			
6	4	Variegated shale			
4		Fire clay and shale	(Bolivar)		
8	3	Light gray shale			
7	3	Fire clay and shale	"		
13	6	Sandstone	(Butler)		
2	6	Gray slate			
1	3	Black slate			
	7	Coal, dirty	(Lower Freeport)	76	10
1	6	Gray slate			
8		Dark sandy shale			
4		Black slate			
1	7	Gray slate			
2	0	Coal	(Upper Kittanning)	96	11
0	4	Slate			
1	6	Coal			
0	1	Slate			
1	1	Coal			
1	10	Fire clay			
3	8	Sandy shale			
5	10	Gray slate			
8	4	Limestone	(Johnstown)	116	7
1	6	Fire clay	(Middle Kittanning		
4	8	Fire clay and shale			
10		Sandy shale			
26	9	Dark gray slate			
0	8	Bony coal	(Lower Kittanning)	163	8
3	6	Coal	" "		
3	10	Fire clay			

Brookville coal and clay. The Brookville coal is the lowest in the Allegheny group, lying commonly within 20 feet of the top of the Homewood sandstone. The coal is of rather poor grade and the bed is extremely split up by many binders of clay and bone. As a rule, the bed is 3 to 6 feet thick, including the binders, where it is well developed, but in many sections the coal is entirely lacking, or represented by a few inches of bone or carbonaceous shale. A plastic fire clay, which in a few places carries balls of flint clay, is associated with the coal. The position of the clay varies; it may lie above the coal, as in the road cut back of the Ohiopyle Hotel, but commonly it lies below the coal, as in the mines on Chestnut Ridge. The interval between the coal and fire clay and the top of the Homewood sandstone is commonly occupied by shale and clay shale with iron ore balls and scattered discontinuous beds of impure clay.

Clarion coal and clay. The Clarion coal commonly lies 10 to 20 feet above the Brookville, but in some places where the Brookville is thickest the two beds may be united. Considerably thinner and less persistent than the Brookville, the Clarion seldom exceeds 1 foot in thickness and is commonly about six inches. It is underlain by a plastic fire clay of poor quality which grades downward into clay shale or sandy clay with iron ore balls which occupy the interval to the Brookville coal. The chief exposures of the Clarion coal are in the vicinity of Ohiopyle, where it is distinguished from the Brookville by the great difference in thickness and by its greater distance above the top of the Homewood sandstone which is well exposed in the Youghiogheny gorge. Elsewhere there are exposures of thin coals which may be either the Clarion or the Brookville, but cannot be differentiated because of a lack of exposures of nearby key beds from which to measure intervals.

Vanport limestone. North of Fayette County the Vanport limestone is well developed and persistent, so that it makes a good horizon marker for the lower part of the Allegheny group. No evidence of the presence of the rock in Fayette County was found, but J. J. Stevenson (1877, p. 81) notes the presence of ferruginous limestone below what he calls the Kittanning coal. Stevenson correlates this limestone as the Ferriferous (Vanport) in his section at Springhill Furnace (1877, p. 141), but it seems more probable that it represents the Johnstown cement limestone which lies above the Lower Kittanning coal, whereas the Vanport (Ferriferous) lies below all the Kittanning coals.

Kittanning (Clarion) sandstone. In the standard section for southwestern Pennsylvania, both the Kittanning and the Clarion sandstones lie between the Lower Kittanning and the Clarion coals. Since the sandstones are normally separated by the Vanport limestone, which is absent in Fayette County, it is impossible to say definitely whether the sandstone lying below the Lower Kittanning coal is the Kittanning or the Clarion, but as the sandstone commonly occurs in the upper part of the interval, it is here called the Kittanning.

The sandstone is commonly medium- to heavy-bedded, but in a few places it becomes massive. It is composed of medium to coarse quartz grains and a relatively small amount of micaceous material. The color is gray when fresh, but in many places sufficient iron is present to stain it brown after weathering. Plant remains may be numerous or entirely lacking, but in all cases observed they are fragmental. Although missing from some sections, or replaced by sandy shale, the sandstone averages about 10 feet thick where seen in the Ohiopyle Valley and reaches a thickness of 23 feet west of Summit on the National Pike, and 20 feet on the Fayette anticline.

Lower Kittanning coal and clay. The Lower Kittanning coal is well developed in parts of Fayette County and because of its purity and constancy over short distances, it is opened in several commercial mines. The thickness ranges from 2 to 5 feet and includes 1 foot or more of bony coal at the top in its thicker development, which, taken with the purity of the bed and the lack of clay and bone binders, serves

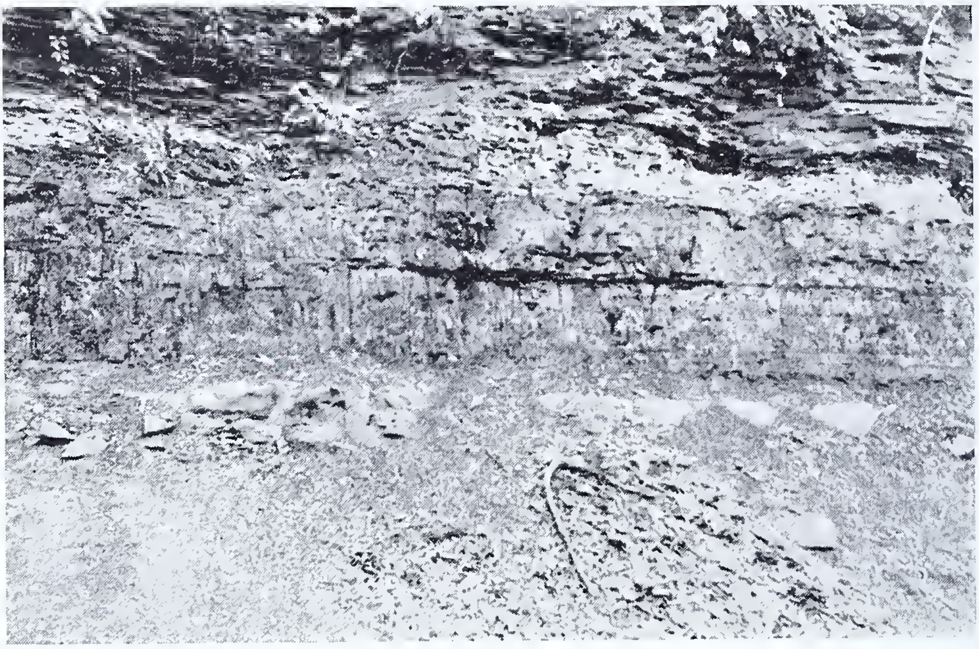

Figure 18. Lower Kittanning coal and fire clay.
South of Indian Head on B. & O. R. R.

in many cases to identify it. In the northern part of the Ohiopyle Valley, near Indian Head, this coal is commercially important. It lies about 150 feet below the Upper Freeport coal and 40 to 60 feet above the Homewood sandstone. Southward in the vicinity of Ohiopyle where the Lower Kittanning is of less commercial importance, the Upper Freeport coal is 140 feet above, and the top of the Homewood is 65 to 75 feet below. The coal is not exposed in the southern end of the valley except along the flanks of Chestnut Ridge and Laurel Hill, and it appears to have thinned. On the west flank of Chestnut Ridge it is only 1 foot thick in some places, but commonly as seen in several country banks all along the ridge it is 2½ to 3 feet of good clean coal. Likewise, on the Fayette anticline where opened or exposed in railroad cuts, it is about 2½ feet thick and clean.

The Lower Kittanning clay lies under the coal and is commonly in contact with it, but in a few places is separated from the coal by a foot of shale. The best exposure is along the railroad south of Indian Head, where there is 4 to 5 feet of clay directly under the coal. It is composed of plastic clay with nearly one foot of flint clay in the middle. Near Ohiopyle the flint clay is present in some of the sections and absent from others, but there are always several feet of plastic clay below the coal. On the western flank of Chestnut Ridge and the Fayette anticline plastic clay is present, but no flint clay was seen at this horizon. Above the Lower Kittanning coal in many places there is a 10- to 15-foot bed of alternate light to dark banded shale in which the bands are only a fraction of an inch thick. Although not universally present, the occurrence of this shale above a coal similar in character to the Lower Kittanning may be used as an additional assurance in naming the coal Lower Kittanning.

Westernport sandstone. The Westernport sandstone lies between the Upper and Lower Kittanning coals. It is commonly divided into two parts by the Johnstown limestone and Middle Kittanning coal, but in the vicinity of Normalville and Whites Bridge the parts have coalesced and cut out the intervening limestone and coal. The sandstone is irregular in extent and character. Commonly it is medium-bedded, fine-grained, brownish, shaly and occurs in two thin beds which are designated Upper and Lower Westernport. It is not uncommon for one or both of the beds to be replaced by shale or sandy shale. The best exposures of the Westernport occur near Whites Bridge in the northern part of the Ohiopyle Valley. The sandstone here is not typical of the rest of the county, but is chiefly interesting because of the great change which has taken place in it. The thickness ranges from 30 to 60 feet and the rock is gray, massive, and conglomeratic. It forms 20- to 30-foot cliffs along the east bank of Indian Creek north of Whites Bridge and might be taken for the Homewood or Mahoning sandstones, which it greatly resembles, except that its position can be definitely shown by means of identifiable coal beds. This marked variation in type might well be regarded as the rule, rather than as an exception in the case of many of the beds in the Coal Measures.

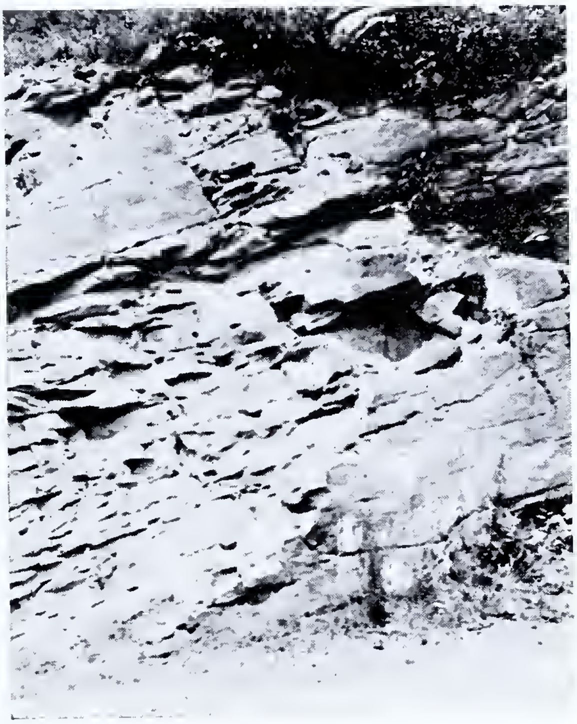

Figure 19. Westernport sandstone ¾ mile east of Hopwood on U. S. Route 40.

Middle Kittanning coal. The Middle Kittanning coal is thin, sporadic, impure and often lacking in Fayette County. It is of no commercial importance. In many of the sections this coal appears as a 6-inch to 1-foot bed approximately 20 feet above the Lower Kittanning coal. It is hard to consider this coal as a distinct bed. It appears rather to be lenses of coal which were deposited in small distinct basins at approximately the same horizon. In a few places the coal is underlain by an impure plastic clay.

Johnstown limestone. The Johnstown limestone was observed in two widely separated places in Fayette County. North of Indian Head in the Ohiopyle Valley several outcrops and many diamond drill records show the presence of a limestone above the Middle Kittanning coal and below the Upper Westernport sandstone. The limestone is gnarly, impure and medium to dark blue-black. No fossils could be found in it. The thickness ranges from nothing to 10 or 12 feet, and the occurrences are localized in an irregular area with its greatest diameter less than 5 miles.

The second place where the Johnstown limestone was observed is in the southern part of the county along the western flank of Chestnut Ridge. Stevenson (1877, pp. 139-140) records the presence of the limestone and calls it the Ferriferous (Vanport). However, it seems more probable that the coal Stevenson calls Kittanning is in reality the Upper and Middle Kittanning. Thus, this limestone would be the Johnstown and lies immediately below the Middle Kittanning coal here, whereas it overlies this coal in the Indian Head area. Stevenson reports that the limestone contains so much iron as to be a calcareous ore, but specimens collected by the writer merely show an impure limestone not particularly high in iron, so it is doubtful if the high iron content is of more than sporadic occurrence. The specimens low in iron are similar to the rock near Indian Head and the only difference is the thickness of the bed, that near Springhill being only 3 to 4 feet thick.

Upper Kittanning coal and clay. The Upper Kittanning coal is recorded in most of the Allegheny sections from Ohiopyle Valley and Fayette anticline, but does not appear in the sections on the west flank of Chestnut Ridge. In the Jacobs Creek section on the western flank of the Fayette anticline the coal is nearly 2 feet thick and rather poor. It does not seem probable that it becomes thicker elsewhere in that region. In the Ohiopyle Valley in many sections this coal is less than 1 foot thick, whereas in an equal number it has a thickness of 5 feet or more, including the clay and shale binders. The coal is not regular, changing its thickness and the position of the binders in short distances. Commonly a clay lies under the coal. In places it may be a nearly pure fire clay, but more often than not it contains iron carbonate or hydroxide (siderite and limonite) balls.

Freeport sandstone. The Freeport sandstone lies below the Lower Freeport coal and fire clay and above the Upper Kittanning coal. Although it was not seen in any of the sections along the western flank of Chestnut Ridge and is replaced by shale in the Fayette anticline section, it crops out in several places in the Ohiopyle Valley and is shown in a few of the measured sections. It is a thin- to medium-bedded, brown, medium-grained micaceous sandstone which in several places shows irregular cross-bedding. The thickness ranges from nothing up to 15 feet exposed in a road cut 1 mile southwest of Indian

Head. Two miles southwest of Markleysburg along the State line a massive sandstone bed crops out which appears to be about 80 to 100 feet below the Upper Freeport coal. This bed is not like the Freeport sandstone seen elsewhere. The lack of any good Allegheny section in this general region makes identification of the sandstone highly problematical, but it may be either Freeport or Upper Westernport.

Lower Freeport limestone. The Lower Freeport limestone is lacking from most of the sections in Fayette County, but a few diamond drill holes and one or two exposures show it directly below or within the Lower Freeport clay. It is a bed 3 to 4 feet thick of light-yellow, clayey, noncrystalline limestone which has the conchoidal fracture of most of the structureless Carboniferous "fresh water" limestones. Outcrops are sporadic and not localized in any particular areas. Commonly iron ore is associated with the horizon and iron carbonate seems to have been an integral part of the bed.

Lower Freeport coal and clay. The Lower Freeport coal is a thin bed commonly lying about 50 feet below the Upper Freeport coal. Not of commercial importance in Fayette County, it has been opened in few country banks and is to be seen in very few places. Up to 3 feet in thickness and of poor grade, the actual coal in the bed would not average over 1 foot. The coal is generally underlain by an impure calcareous clay which does not make good fire clay.

Butler sandstone. The Butler sandstone is a thin-bedded, shaly sandstone that lies between the Upper and Lower Freeport coal beds. In Fayette County it is commonly replaced by sandy shale. This sandstone may lie above or below the Bolivar fire clay. Being valueless commercially and as an horizon marker, it is of little interest in Fayette County.

Bolivar fire clay. In many of the older reports the name Bolivar fire clay has been so loosely used that considerable confusion has developed. Going back to the original use of the name it becomes evident, however, that the Bolivar fire clay lies a considerable distance below the Upper Freeport coal, whereas the clay immediately under the coal should be called the Upper Freeport fire clay. The Bolivar fire clay horizon is commonly made up of plastic and flint clay in variable proportions, but in several places it is composed of balls of fire clay horizon is commonly made up of plastic and flint clay in as great as 20 feet of good clay. It lies 20 to 50 feet below the Upper Freeport coal.

Upper Freeport limestone. The Upper Freeport is a sporadic 3- to 5-foot bed of massive "fresh water" limestone lying a few feet below the Upper Freeport coal. It is commonly separated from the coal by fire clay and in many places is also underlain by a few feet of fire clay. The limestone is light gray and very hard, breaking with conchoidal fracture. Outcrops are scarce because of the thinness of the bed, and, more often, its absence from the section.

Upper Freeport coal and clay. The Upper Freeport coal is the highest member of the Allegheny group. It is very persistent, 3 to 4 feet thick, and commonly divided into two benches by several inches of fire clay. Either or both of the benches may contain thin fire clay or bony partings. Although seldom seen in outcrop, a very large number of country banks expose this coal thoroughly in most of the areas of Allegheny sediments in Fayette County. Along the west flank of Chestnut Ridge in southern Fayette a great thickness of this bed is recorded. It is believed, however, that the unusual thickness is caused by a rider coal several feet above the main bed and separated from it by plastic clay. The actual coal thickness is not very much greater here than in other parts of the county.

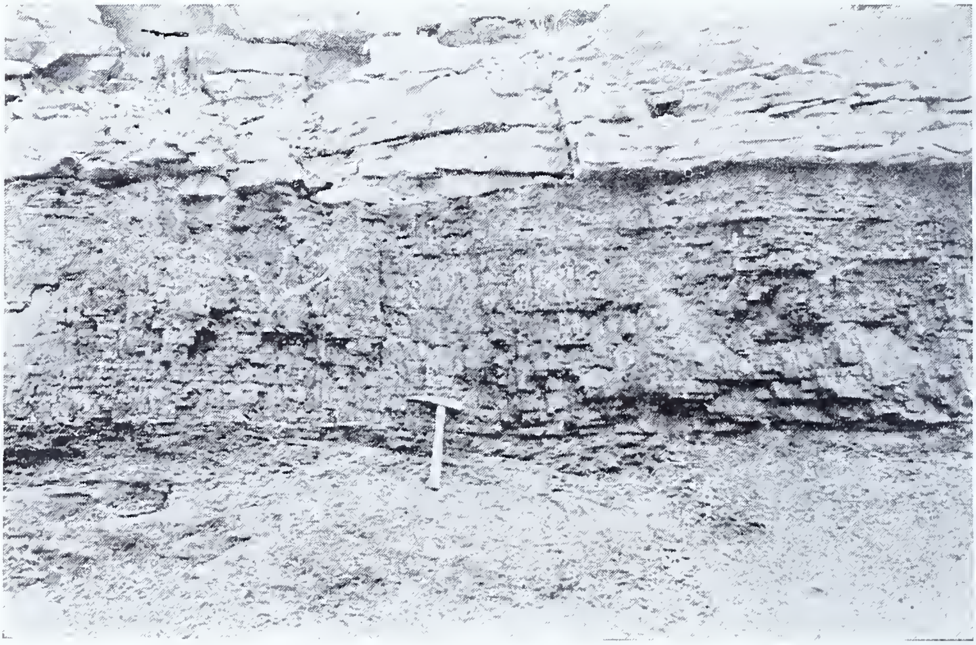

Figure 20. Upper Freeport coal north of Normalville.

The Upper Freeport fire clay lying directly below the coal is largely plastic clay with a small amount of flint clay. In a few places, however, up to 7 feet of flint clay has been recorded. Commonly there are 5 to 7 feet of clay in all, but at some places thickness of 15 or more feet is known. In the places of greatest thickness the Upper Freeport limestone is not present, but where the limestone is present the greater part of the clay lies above it.

Thickness of Allegheny group. The Allegheny section on the Fayette anticline indicates a general thickness of 220 to 225 feet for the group in the western part of the county and several sections in the Ohiopyle Valley indicate a thickness varying from 195 to 230 feet and averaging 215 feet. Sections along the western flank of Chestnut Ridge, however, indicate a general thickness of 150 to 160 feet. Since the latter area lies between the first two, some explanation must be sought for the variation.

Thinning on the flanks of folds with concomitant thickening along the axes offers a ready answer when the facts are looked at in general, but on close examination does not fit so well. Unfortunately nowhere in the steeply folded part of Chestnut Ridge has more than the very lowest part of the Allegheny group been preserved along the axial line, so it is impossible to determine the relative Allegheny thickness on the crest and flanks of the anticline. However, it is believed that the intensity of the folding is not sufficient to have caused such a remarkable change (25 percent) in the thickness of the strata by means of squeezing out along the flanks of the fold. Furthermore, the thinning is not uniformly distributed through the Allegheny section, but has been confined to the upper part of the Kittanning group of beds, leaving the other parts nearly identical in thickness throughout the county. If the thinning had been caused by the squeezing out of material, it should not have taken place through the actual elimination of part of the section, leaving the rest unaltered.

Another hypothesis is found in the non-deposition of some of the Allegheny beds or their erosion before subsequent deposition took place. Such an idea presupposes the presence of a positive area in the Allegheny depositional basin. This hypothesis not only meets the objections stated above, but is borne out by the character in adjacent regions of the beds that are cut out in the positive area. The coals of the upper part of the Kittanning group of beds and the Lower Freeport coal just above it are so irregular that it seems probable they were formed in several small basins rather than in one large basin which included the whole region. Likewise, the most striking sandstone in the whole Allegheny section is in the upper and middle parts of the Kittanning surrounding Chestnut Ridge, but is lacking on the ridge.

An interesting aspect of the postulated positive area lies in its coincidence in position with the Chestnut Ridge anticline. If uplift produced a positive area along the anticline, it indicates that one of the major structural features of the Appalachian orogeny in Fayette County began its development as early as Allegheny time. The broader extension of the idea to include the whole length of Chestnut Ridge anticline and the other major anticlines would give proof of such an early beginning of the Appalachian orogeny. The continuation of movement and the perpetuation of a partial positive area along the anticlinal axis is indicated by the marked differences in the lower Conemaugh group which has been preserved in the adjacent synclines, as will be brought out in the section on the Conemaugh group.

Unfortunately, the Allegheny group on Laurel Hill anticline is so eroded and so poorly exposed within Fayette County that it is not possible to obtain data good enough to throw further light on this question.

CONEMAUGH GROUP

General account. The Conemaugh group was formerly called the Lower Barren Measures and lies between the Allegheny and Monongahela groups. The name Conemaugh comes from the Conemaugh River along which the group is well exposed. The group consists of sandstone, red and gray shale, limestone, thin coal beds, and small amounts of low-grade fire clay. The base is at the top of the Upper Freeport coal and the top at the base of the Pittsburgh coal. The group has been divided into nine parts, which are designated Mahoning, Buffalo, Saltsburg, Grafton, Barton, Morgantown, Lonaconing, Connellsville and one which has not been named but contains the Little Pittsburgh coal. In this report the group will be treated as a whole and has been mapped as a unit. Many of the individual beds have been named because of their economic importance or their prominence in the field. They will be discussed individually below.

Generalized sections of Conemaugh group.

Name and character of strata	Variation in thickness (feet)	Distance above top of Upper Freeport coal, in feet		
		Fayette anticline	Ohiopyle syncline	Johnstown syncline
Pittsburgh coal		640	Eroded	Eroded
Upper Pittsburgh limestone	0–2	620		
Lower Pittsburgh sandstone	10–30	590		
Little Pittsburgh coal	0–1	580		
Lower Pittsburgh limestone	0–2	575		
Connellsville sandstone	50–80	510		
Little Clarksburg coal	1	505		
Clarksburg limestone	2–5	500		
Clarksburg red shale	0–20	485		
Clarksburg limestone	0–2	483		
Lonaconing coal and clay	0–20	480		
Morgantown sandstone	50–80	425		525
Barton coal	1–2	420		?
Barton limestone	2–4	410		?
Birmingham red shale	10+	400 ?		?
Washington red shale	?			?
Ames limestone	0			Absent
Harlem coal	2–3	300		400
Ewing limestone	5–10	285		390
Pittsburgh redbeds	0–30	?		360
Saltsburg sandstone	80	195	260	275
Upper Bakerstown coal	2–3	190	250	270
Cambridge red shale	0–12	Absent	230	250
Woods Run limestone, fossiliferous	0–3	?	220	240
Lower Bakerstown or Thomas coal	0–2		182	?
Cambridge limestone	0–2	180 ?	180	190
Buffalo sandstone	10–40	145	150	150
Meyersdale red shale	5–15	140	145	145
Brush Creek limestone	1–3	130	130	130
Brush Creek coal	2–3	120	120	125
Upper Mahoning sandstone	20–40	60–70	90	85
Upper Mahoning coal	0–3	Coal, clay, and red shale at 40–50	85	Absent
Upper Mahoning limestone	0–2		80	80
Upper Mahoning fire clay	2–5		75	80
Mahoning red bed	0–4		70	75
Middle Mahoning coal	0–5		65	70
Mahoning limestone and clay	0–4		55	65
Lower Mahoning coal	0–1		50	55
Lower Mahoning sandstone	10–50	0–25	0–40	5–40
Piedmont coal	0–½	Absent	35	?
Upper Freeport Rider coal	0–1	5–10	10–15	10–20
Uffington shale	0–25	0	0	0
Upper Freeport coal				

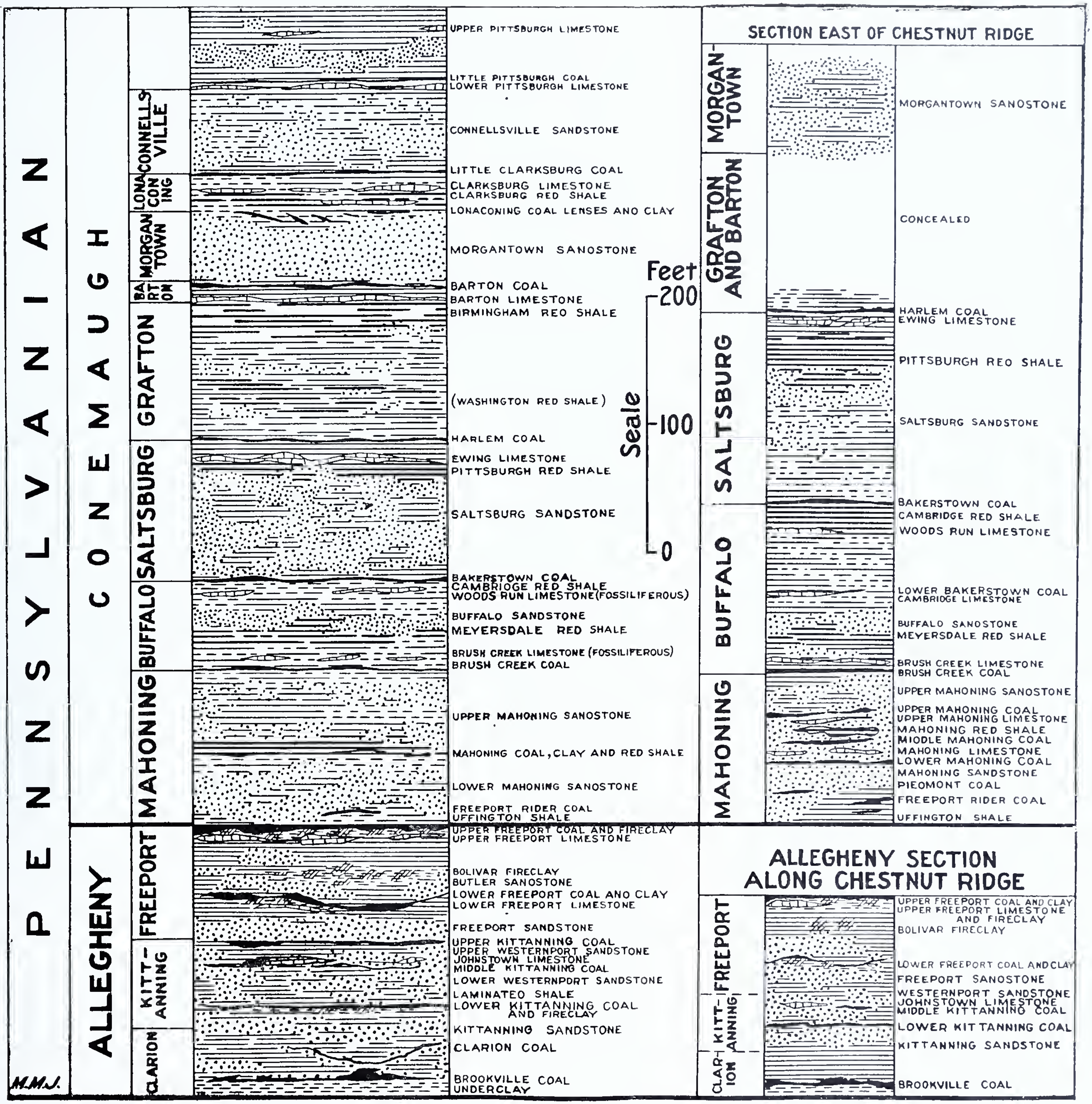

Figure 21. Columnar section of Allegheny and Conemaugh groups in Fayette County.

Three generalized sections are given here as the variation in the Conemaugh group is so extreme between certain parts of the county that one section would not serve to show the strata adequately. These generalized sections are composed from many partial sections gathered throughout the county and are meant to represent an average picture. The intervals between named beds in many of the individual sections differ considerably from those given in the generalized section.

Areal distribution. The Conemaugh group crops out throughout Fayette County. In the northwestern corner of the county the top of the group comes above drainage along the Monongahela River and the lower reaches of three of its tributaries. Northeast of Brownsville the same strata appear again along the Monongahela and also along the lower part of Redstone Creek. Conemaugh rocks crop out along the Fayette anticline in a zone 7 to 8 miles wide at the north boundary of the county and 2 miles wide east of Masontown. From this point south the outcrop widens to include the whole southwest corner of the county except for the higher hills which are capped by the basal members of the Monongahela group. A narrow band of Conemaugh rocks extends along the foot of the western flank of Chestnut Ridge.

The floor of the Ohiopyle Valley is largely composed of lower Conemaugh rocks. South of Ohiopyle the whole surface of the valley is underlain by the Mahoning, Buffalo and Saltsburg members of this group except along the courses of the larger streams which have exposed the top of the Allegheny group. On the other hand, north of Ohiopyle the strata lie higher in relation to the surface and the same Conemaugh members are found well up on the hillsides and capping the hilltops. At the southern end of Laurel Hill the basal Conemaugh beds extend far up the flanks and are nearly continuous across the top on the Pennsylvania-Maryland-West Virginia boundary. East of Laurel Hill the lower and middle Conemaugh are preserved in the hills along the Johnstown syncline.

Measured sections of the Conemaugh. Nowhere in the county is it possible to measure a complete section of the Conemaugh, but many exposures present 50 to 100 feet of the strata and a few as much as 200 or 300 feet. The best of these sections will be given below.

Lower Conemaugh section on National Pike,
2 miles west of Somerfield

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet (estimated)
	Concealed		
2	Weak sandstone		285
5	Shale		
3	Sandstone		
12	Buff shale		
12	Red shale (papery)	(Cambridge)	251
2	Limestone	(Woods Run)	249
9	Buff shale (reddish)		
18	Shale and concealed		
18	Crumbly olive shale		
36	Dark fossiliferous shale, limy at top	(Cambridge limestone)	200
31	Gray sandy shale	(Buffalo)	137
2	Dark shale		
1	Limestone, fossiliferous	(Brush Creek)	134
6	Dark shale		
3	Coal and bone	(Brush Creek)	125
2	Limy blue clay		
28	Buff sandy shale	(Upper Mahoning ss)	89
6	Shale and sandstone		
8	Clay with lime nodules	(Upper Mahoning limestone)	
2	Soft purple shale	(Mahoning red bed)	79
1	Sandstone		
4	Greenish shale (iron nodules)		
4	Plastic clay, dark at top	(Mahoning)	70
2	Sandy shale		
½	Nodular limestone	(Mahoning)	67
24	Light-buff shale		
1	Nodular iron ore		
9	Dark clay shale		
	Concealed		

Lower Conemaugh section ½ mile north of Somerfield
on the west bank of the Youghiogheny River

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet
	Sandstone and concealed		
5	Gray shale		
1	Nodular limestone	(Mahoning)	67
½	Coal	(Mahoning)	66
6	Shale and clay shale		
30	Hard sandstone (cliff)	(Lower Mahoning)	
30	Concealed		
	Coal	(Upper Freeport)	

These sections supplement each other in such a manner that it is possible to obtain a complete section of the lower Conemaugh in the Johnstown syncline. The high hills are composed of strata as far up in the Conemaugh group as the Morgantown sandstone, but outcrops are so infrequent that it was not possible to measure a detailed section. Such data as were collected about the strata above the Woods Run limestone are brought together in the generalized section.

Lower Conemaugh section on road 1 mile north of Farmington

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet
	Concealed		
10	Sandstone float	(Upper Mahoning)	
3	Clay		
1	Coal	(Upper Mahoning)	83
2	Plastic clay		
4	Red to pink shale	(Mahoning red bed)	77
12	Light-buff sandy shale		
2	Coal	(Middle Mahoning)	63
6	Dark to black fissile shale		
2	Coal	(Lower Mahoning)	55
4	Gray clay shale		
9	Slabby sandstone	(Lower Mahoning)	
3	Concealed		
6	Massive sandstone		
8	Concealed		
½	Coal	(Freeport rider or Piedmont)	25
7	Brown shale		
8	Concealed and black shale		
4	Weak sandstone		
6	Shale	(Uffington)	0
	Coal	(Upper Freeport)	

Lower Conemaugh section from diamond drill hole on the O'Neil farm 2½ miles southeast of Elliottsville

Thickness Ft.	in.	Character of beds	Name	Above top of coal Upper Freeport Ft.	in.
10		Surface			
34	8	Sandstone	(Upper Mahoning)	102	2
	6	Soft shale			
0	4	Bone and slate	(Upper Mahoning)	100	2
0	3	Clay			
0	11	Bone			
1		Fire clay			
28	4	Light shale			
1	6	Limestone	(Mahoning)	69	4
2	6	Fire clay	(Mahoning)	66	10
21	6	Light shale			
10		Sandstone	(Lower Mahoning)		
0	9	Coal and slate	(Piedmont)	34	7
12		Sandy shale			
13	9	Sandstone	(Lower Mahoning)		
8	10	Dark sandy shale	(Uffington)	0	0
		Coal	(Upper Freeport)		

Lower Conemaugh section from diamond drill hole on Henry Hall farm ½ mile southeast of Poplar Run School

Thickness				Above top of Upper Freeport coal	
Ft.	in.	Character of beds	Name	Ft.	in.
14		Surface			
3	6	Dark gray shale			
	6	Coal	(Brush Creek)	114	6
4		Fire clay	(Brush Creek)	110	6
52		Light shale			
51	4	Sandstone	(Upper and Lower Mahoning)	7	0
7		Dark gray slate	(Uffington)	0	0
		Coal	(Upper Freeport)		

Lower Conemaugh section from diamond drill hole on John Faust farm, 1 mile southeast of Melcroft

Thickness				Above top of Upper Freeport coal	
Ft.	in.	Character of beds	Name	Ft.	in.
2		Surface			
16		Sandstone with shale streaks	(Buffalo)	161	2
10		Dark sandy shale			
17		Dark shale			
1		Limestone	(Brush Creek)	143	2
7		Dark sandy shale			
2		Sandstone	(Upper Mahoning)	134	2
23		Dark shale			
7		Fire clay			
2		Limestone	(Upper Mahoning)	102	2
19		Clay shale			
22	6	Light sandy shale			
2	6	Gray shale			
0	8	Coal	(Mahoning)	56	7
0	2	Binder			
0	9	Coal			
4		Fire clay	(Mahoning)		
6	5	Sandstone			
2	8	Gray shale			
1	6	Limestone	(Mahoning)	42	0
2		Fire clay	(Mahoning)		
3	6	Clay and limestone			
14	4	Light shale			
14		Sandstone	(Lower Mahoning)		
7		Dark sandy shale	(Uffington)	0	0
1	2	Black shale			
		Coal and slate	(Upper Freeport)		

Lower Conemaugh section from diamond drill hole on George Emerick farm, 1 mile south of Donegal

Thickness Ft.	Thickness in.	Character of beds	Name	Above top of Upper Freeport coal Ft.	Above top of Upper Freeport coal in.
20		Surface			
12		Dark-gray shale			
15		Light-gray shale			
9		Fire clay and shale			
16		Sandstone	(Upper Mahoning ?)	68	5
8		Sandy shale			
8	4	Light-gray shale			
0	11	Coal, dirty	(Mahoning)	51	2
10		Fire clay and shale	(Mahoning)		
7		Sandy shale			
6		Sandstone	(Lower Mahoning)	28	2
18½		Light-gray shale			
9½		Dark-gray shale	(Uffington)	0	0
		Coal	(Upper Freeport)		

These five sections are in the Ohiopyle Valley along the Ligonier syncline. They indicate the variation in the Mahoning member and in the overlying beds. The detail is extremely irregular throughout, especially as regards the coal beds which come and go in closely adjacent areas. For this reason it is extremely difficult to make a generalized section which represents even a fair proportion of the beds at any one spot.

Lower Conemaugh section at Springhill Furnace

Measured by J. J. Stevenson (1877, p. 141)

Thickness Ft.	Thickness in.	Character of beds	Name	Above top of Upper Freeport coal Feet
		Concealed		
15		Sandstone	(Saltsburg)	238
20		Shale		
3	3	Coal and binder	(Bakerstown)	203
5		Shale		
55		Concealed		
30		Sandstone	(Buffalo)	113
6		Coal and shale	(Brush Creek)	107
35		Concealed		
10		Ferruginous limestone and shale	(Mahoning)	62
55		Sandstone and shale	(Lower Mahoning)	
6	9	Clay shale and coal streaks	(Uffington)	0
9	6	Coal and clay	(Upper Freeport)	

This section is very incomplete and exposures near the furnace at present are even less complete than formerly. It is given here, however, since it is the best that could be obtained for the southwestern part of the county.

Upper Conemaugh section, ½ mile south of Gans

Thickness Feet	Character of beds	Name	Below Pittsburgh coal Feet
	Sandstone	(Upper Pittsburgh)	
9	Coal	(Pittsburgh)	
65	Concealed		
15	Light-buff sandy shale		
5	Sandstone	(Connellsville sandstone) 50 feet	
10	Concealed		
10	Fissile sandy shale		
10	Concealed		
6	Buff shale		
4	Sandstone		
5	Very sandy shale		130
1	Carbonaceous shale	(Little Clarksburg coal ?)	131
5	Clay with lime nodules	(Clarksburg limestone)	136
1	Iron ore		
8	Buff shale		
5	Concealed		
2	Red shale	(Clarksburg red bed)	152
1	Plastic clay		
2	Impure flint clay (limy)	(Clarksburg limestone)	155
	Concealed		

Lower Conemaugh section along National Pike east of Hopwood

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet
	Concealed	(Saltsburg sandstone) (70 feet)	
30	Massive sandstone		
20	Heavy bedded sandstone		215
20	Massive sandstone		
40	Concealed		
5	Red shale	(Meyersdale red bed)	170
30	Thin bedded sandstone with shale	(Buffalo)	140
2	Red shale	(Meyersdale red bed)	138
1	Gray shale		
10	Shale and sandy shale		
15	Dark shale, fossiliferous, limy at center	(Brush Creek horizon)	112
10	Dark sandy shale		
35	Concealed		
5	Sandstone	(Upper Mahoning)	62
10	Concealed		
2	Clay shale and clay	(Mahoning)	50
20	Concealed		
30	Hard sandstone	(Lower Mahoning)	0
	Coal	(Upper Freeport)	

Lower Conemaugh section on south bank of Youghiogheny River, west flank of Chestnut Ridge

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet
14	Shale partially concealed		
1	Coal	(Brush Creek)	107
30	Clay and shale		
25	Hard sandstone	(Upper Mahoning)	52
30	Concealed		
2	Coal	(Piedmont ?)	20
20	Sandstone and shale	(Lower Mahoning)	0
	Coal	(Upper Freeport)	

Middle and upper Conemaugh sections on Dunbar Creek

Measured by J. J. Stevenson (1877, p. 182) Revised W. O. H. 1934

Thickness Feet	Character of beds	Name	Below Pittsburgh coal Feet
	Coal	(Pittsburgh)	
35	Concealed		
10	Sandstone	(Lower Pittsburgh)	
½	Coal	(Little Pittsburgh)	45
3	Clay		
20	Shale and limestone	(Lower Pittsburgh)	68
60	Sandstone	(Connellsville)	128
20	Shale		
5	Limestone	(Clarksburg)	153
5	Gray and red shale	(Clarksburg red bed)	158
55	Sandstone	(Morgantown)	213
12	Sandy shale		
1	Coal	(Barton)	226
12	Shale		
50	Concealed		
35	Variegated shale, in part red	(Washington red bed)	
2	Coal and clay	(Harlem)	325
20	Brown shale		
40	Sandstone	(Saltsburg)	430
45	Sandy shale		
2	Coal	(Bakerstown)	432
53	Shale		
3	Limestone	(Cambridge)	488
7	Shale		
10	Shaly sandstone	(Buffalo sandstone)	505
25	Imperfectly exposed		
2	Coal	(Brush Creek)	532

The Dunbar Creek section seems very poor. It must have been compounded from several imperfect exposures, and the remeasuring did not produce a section as complete as Stevenson's, but was sufficient to make a certain amount of revision of the former section necessary.

Upper Conemaugh section, 1 mile northeast of Connellsville

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet (estimated)
	Concealed		
10	Thin bedded sandstone	(Connellsville sandstone) 55 feet	
30	Concealed		
12	Sandy clay		
3	Hard sandstone		
½	Coal	(Little Clarksburg)	505
2	Clay		
3	Knobby limestone	(Clarksburg)	500
15	Red shale and concealed	(Clarksburg)	485
20	Dark clay shale, coal lenses near top	(Lonaconing)	475
30	Sandy shale and sandstone	(Morgantown sandstone) 40 feet	
10	Medium bedded sandstone		
	Concealed		

Upper Conemaugh section in cliff at Moyer

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet (estimated)
	Concealed		
10	Hard, gray sandstone	(Connellsville)	513
2	Clay shale		
1	Coal	(Little Clarksburg)	510
5	Impure fire clay		
5	Limestone	(Clarksburg)	500
15	Red and buff shale	(Clarksburg)	485
	Concealed		

Upper Conemaugh section southwest of Vance Mills on Route 51

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet
	Concealed		
12	Sandstone	(Connellsville sandstone)	
3	Clay with iron nodules		
6	Sandstone and shale		
2	Clay shale		
15	Sandstone		
½	Coal	(Little Clarksburg)	
25	Shale and clay shale		
	Concealed		

Middle Conemaugh section south of Upper Middletown on Route 51

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet (estimated)
	Sandstone	(Morgantown)	
20	Light sandy shale		
7	Sandstone and shale		432
12	Black shale		
2	Coal	(Barton)	420
1	Black shale		
3	Impure plastic clay		
4	Light clay shale		
3	Limestone, knobby	(Barton)	409
10	Red and pink shale	(Birmingham)	399
	Concealed		

Middle Conemaugh section on Route 51 near Rothrock

Thickness Feet	Character of beds	Name	Above top of Upper Freeport coal Feet (estimated)
2	Coal	(Harlem)	305
15	Clay shale		
5	Limestone, gnarly	(Ewing)	285
1	Limy clay		
2	Black shale		
6	Red shale	(Pittsburgh red bed)	276
	Unconformity		
4	Sandstone	(Saltsburg) (sandstone)	
25	Sandy clay shale with iron nodules in upper 10 feet		
30	Cross-bedded hard, gray sandstone		

The Harlem coal is only a bloom in the section, but nearby country banks show 2 and 3 feet of coal. The 9 feet of shale and clay below the Ewing limestone disappear to the north and south along the road and there the limestone rests on the Saltsburg sandstone. The Saltsburg sandstone includes a sandy clay shale which can be traced horizontally into hard sandstone within a few hundred yards of the section.

Measured Conemaugh sections west of Chestnut Ridge are shorter and more incomplete than those obtained east of the ridge. The data, such as they are, however, point to several general conclusions. The Conemaugh is more regular in thickness west of Chestnut Ridge than to the east, and most of the individual beds are more persistent. Although it is not possible to compare the total Conemaugh thickness throughout the county, measurements show that there is thickening towards the east. Below the Brush Creek coal the thickness is fairly constant in an east-west direction across the major structures, but the strata above the Brush Creek coal show a marked thickening to the east. The average interval between the Brush Creek coal and the base of the Saltsburg sandstone is 75 feet west of Chestnut Ridge, 140 feet in the Ohiopyle Valley, and 155 feet in the Johnstown syncline. The major change seems to take place abruptly along the line of Chestnut Ridge.*

The total thickness of the Conemaugh group averages 640 feet west of Chestnut Ridge, which is the only place in the county where the upper members have not been completely removed by erosion. Variation from the average is very small as far as can be told from well logs and such other data as could be obtained. This constancy of thickness is especially remarkable when the extreme variation of the members of the group is considered. For instance, some of the thick sandstone members show a variation in composition from nearly all sandstone to little sandstone and nearly all shale or sandy shale. The red shales may completely disappear or be replaced by gray or buff shales. Limestones and coal beds come in and drop out of the section. Thus, not only must there have been original differences in thickness of some magnitude, but also the greater compaction of shale than the horizontally equivalent sandstone would add to the irregularity. Yet, the fact remains that in total thickness little variation is shown. It is thought that the answer lies in repeated planations during deposition, traces of which can be seen in many exposures. One such planation was observed near Rothrock and can be seen in the section at that place which is given above. By means of these planations, the irregularities developing by unequal deposition and compaction of the loose material were largely compensated by the erosion which cut off the top of the originally thicker or less compactable areas.

Uffington shale. The Uffington shale is the lowest member of the Conemaugh group, lying between the Lower Mahoning sandstone and the Upper Freeport coal. In most places the shale is not present, having been cut out by the sandstone which not only is commonly in contact with the Upper Freeport coal, but in a few places has even cut out its upper part. The shale was named by I. C. White from its outcrop at the village of that name south of Morgantown, West Virginia. The exposure at the village not only contains an abundant flora, but also a marine fauna which is listed by White.[11] In Fayette County no fauna was seen, but plant remains are not uncommon. The shale is extremely irregular in occurrence and in places may easily be confused with a shaly phase of the Lower Mahoning sandstone. The Uffington shale in Fayette County ranges from 0 to 20 or more feet thick, and is composed largely of clay and clay shale. It may contain carbonaceous beds and it is believed that the Upper Freeport Rider coal forms a part of it. The shale is developed better in the southern than in the northern part of the county.

Piedmont or Upper Freeport Rider coal. At several places, mostly in the southern part of Fayette County, a thin coal was observed 15 to 40 feet above the Upper Freeport. It is commonly 6 inches to 1 foot thick and extremely variable in occurrence. It is of no commercial importance. The coal may be entirely surrounded by shale or may be a lens in the lower part of the Lower Mahoning sandstone. Whether this coal represents two beds, one in the Uffington shale and one a part of the Lower Mahoning sandstone, cannot be determined from the available evidence. So it is not possible to say whether it correlates with the Piedmont coal, which is a part of the Lower Mahoning sandstone in southwestern Pennsylvania, or with the Upper Freeport Rider coal of the Castleman Basin in Somerset County, or represents both beds.

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* Studies by Charles K. Swartz (Md. Geol. Surv., Vol. II, 1922, pp. 337-338) indicated that the thickening of the Conemaugh eastward is owing to the entrance of members in the upper part which are lacking at the west. This suggests that the supposed Saltsburg sandstone east of Chestnut Ridge may be a higher sandstone than the sandstone called Saltsburg west of the ridge.

[11] I. C. White, The Appalachian coal field: West Va. Geol. Surv., vol. II, part II, pp. 323-325, 1903.

Lower Mahoning sandstone. The Lower Mahoning sandstone is the lowest sandstone in the Conemaugh group and it either rests directly on the Upper Freeport coal bed or is separated from it by the Uffington shale. The sandstone is persistent throughout Fayette County, but commonly a part of it is represented by sandy shale. The change from hard massive sandstone and conglomerate to sandy shale may take place in a short distance, as can be seen in the hill east of Champion. On the east side of the hill the Lower Mahoning crops out in a cliff and has a sandstone thickness of 30 to 40 feet. On the west side of the hill barely 300 yards from the first exposure, the section above the Upper Freeport coal can be seen in a road gutter. Except for 5 feet of sandstone directly on the coal, the rest of the Lower Mahoning interval is occupied by shale and sandy shale.

The material forming the Lower Mahoning varies from buff or gray shale through sandy shale and shaly sandstone to hard, massive, cliff-forming sandstone which may contain conglomeratic lenses. The sandstone is commonly medium to coarse grained, and where not cemented by clay material, it is rather porous. The color of the fresh rock is gray, but weathering in some places produces sufficient limonite to stain the rock brown. The best exposures of the massive sandstone may be seen along the Youghiogheny River above and below Somerfield, along Little Sandy Creek below Gibbon Glade, along the west bank of Indian Creek at the Fayette-Westmoreland County boundary line, and along the south bank of Youghiogheny River at the bridge between Perryopolis and Layton. The conglomeratic facies is best exposed in float blocks along Feik Run, ½ mile north of Five Forks.

Mahoning coals, clays, limestones, and red shale. Between the Upper and Lower Mahoning sandstones in many places there occurs a shale interval which may contain up to three beds of coal, several beds of impure fire clay, one or two limestone horizons, iron ore, and a bed of red shale. Many names have been applied to various members of this group in the past, as Thornton fire clay (W. Va.), Johnstown iron ore, Gallitzin coal, etc., but for the sake of simplicity they will be called here by the name Mahoning.

The coals are well exposed on the north side of the second hill north from Farmington along the road to Ohiopyle. Three Mahoning coals are present in the section measured at this exposure (see Farmington section given above), the upper of which is 1 foot thick and the two lower are each 2 feet thick and, although separated by 6 feet of dark shale, might be considered as two benches of the same coal bed. No other outcrop of this group in Fayette County has exposed more than one coal bed, but the variability in the position of the one bed is such that it suggests these exposures represent one or the other of two separate beds. The thickness of any of these coals is quite variable, changing in a short distance from 0 to 2 or 3 feet. At one exposure a few miles south of Farmington a 5-foot coal seam has been opened which is considered to represent the two lower coals in the Farmington section.

The Mahoning limestone seems likewise to occur at two horizons, one of which lies under the upper coal and the other is associated with the two lower coals and may lie between them or possibly below both. They are non-fossiliferous, fine-grained clay limestones when well developed, but in many places are merely limy nodules in low-grade plastic clay.

A bed of red shale commonly from 2 to 5 feet thick but absent in many places lies between the upper and lower coal and limestone. The red shale bed is commonly useful in determining which coal or limestone is present in an exposure where the whole section is not visible because it seems to hold a constant place in the section. Iron ore nodules occur commonly in the shale accompanying these coals and limestone, but only in a few places was a bed of ore seen. This bed probably represents the Johnstown ore bed and occurs under the lowest coal and limestone. It is represented in the section west of Somerfield and was seen at several places in the northern part of the Ohiopyle Valley.

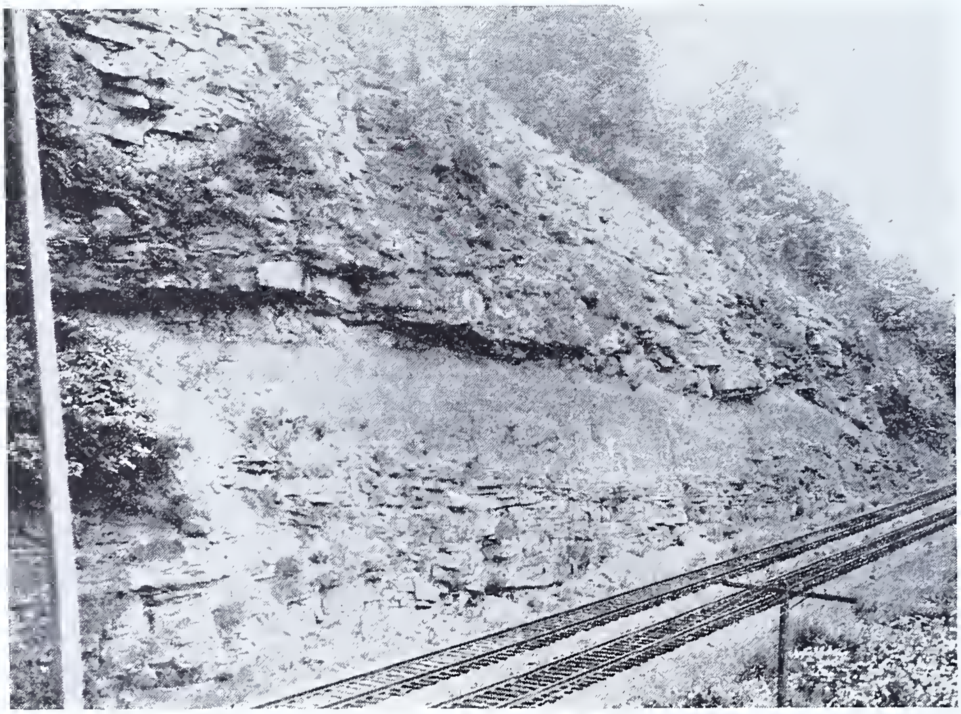

Figure 22. Mahoning sandstone along Youghiogheny River south of Layton.

The aggregate thickness of the several beds between the two Mahoning sandstones ranges from 0 to 50 or 60 feet. In places the Upper and Lower Mahoning sandstones meet, cutting out all the strata commonly lying between them, as can be seen in some of the records of the diamond drill holes along Indian Creek. At other places, as in the cliffs south of the Youghiogheny River at Layton, the sandstones are separated by a few feet of gray or buff shale which shows no signs of limestone, clay or coal. In most places, however, the sandstones are separated by 30 or more feet of shale which commonly contains at least one coal or limestone bed.

Upper Mahoning sandstone. The Upper Mahoning sandstone lies above the Mahoning coals and below the Brush Creek strata. The variability between sandstone and sandy shale is similar to that of the Lower Mahoning sandstone, but possibly shale replaces sandstone in more places. Conglomerate lenses are less frequent, although a few were observed. The sandstone is coarse to medium grained; unweathered rock is gray; weathered commonly is brownish. This sandstone forms fewer cliffs than the Lower Mahoning, but coarse float is common on the outcrop.

Brush Creek coal. The Brush Creek coal as well as the accompanying limestone were named by I. C. White[12] from their occurrence along Brush Creek in Butler County. In earlier reports they had erroneously been correlated with the Elk Lick coal of Somerset County. About the same time the same coal in Blair and Huntingdon counties was named the Gallitzin, but since the name Brush Creek has been more widely used, it is adopted here. The coal lies between 100 and 125 feet above the Upper Freeport coal and with the overlying limestone and marine fauna forms a fairly good horizon marker. The coal is from 1 to 3 feet thick, and in some places is overlain by several feet of black shale. The coal is not persistent but commonly either coal or carbonaceous shale can be found in good exposures of the horizon. The coal is opened in a few country banks, but it is not mined extensively.

Brush Creek limestone and faunal zone. The Brush Creek limestone lies 5 to 10 feet above the coal. Commonly it is less than 3 feet thick, and in many exposures it is merely a bed of calcareous nodules in shale. In all observed occurrences, the limestone carries marine fossils and in several places fossils were found in the shale between it and the Brush Creek coal.

Buffalo sandstone. The Buffalo sandstone was named by I. C. White (Report Q, Second Pennsylvania Geological Survey, page 33) from its occurrence along Buffalo Creek in Butler County where it lies between the Brush Creek and Cambridge faunal zones and is 140 to 150 feet above the Upper Freeport coal. Throughout most of Fayette County west of Chestnut Ridge it is a thin, weak sandstone or sandy shale. However, along the western foot of Chestnut Ridge in the vicinity of Wooddale the Buffalo sandstone thickens and crops out in low bluffs. M. R. Campbell (1903) has considered the outcrop to represent the Mahoning sandstone and the coal lying below the cliff to be the Upper Freeport. When the field work for this report was in progress it could be clearly seen that this sandstone is the Buffalo, not only from the better exposed general stratigraphy of the region, but also because recent coal openings exposed the Brush Creek coal at the base of the cliff and the Upper Freeport approximately 100 feet lower in the section.

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[12] I. C. White, Beaver River District: Second Penna. Geol. Surv., rep. Q, pp. 34-35, 1878.

In the Ohiopyle Valley the Buffalo sandstone is thicker and more massive than west of Chestnut Ridge. In the northern part of the valley it is slightly thinner and not nearly as hard as in the southern part. The northern outcrops are marked by medium- to thin-bedded sandstone float and road cuts show moderate thicknesses of soft to medium, cross-bedded sandstone. Southward from the National Pike and especially around Gibbon Glade, however, the sandstone becomes massive and hard, and shows a few conglomerate lenses. In appearance and outcrop it greatly resembles the Mahoning and Saltsburg sandstones and is easily confused with them. When fresh it is coarse grained and gray, but weathering commonly brings out megascopic blebs of yellow limonite which give the rock a buff to brownish color. In Preston County to the south the sandstone becomes still more massive and thicker and forms prominent cliffs.[13]

Meyersdale redbed. Red shales 10 to 15 feet thick are associated with the Buffalo sandstone. The name Meyersdale was given to them by C. K. Swartz[14] from a very fine exposure in a Western Maryland Railway cut east of Meyersdale, Somerset County. The shale is fairly free from sand, but a few exposures show red sandy shale. Commonly all or a great part of the shale lies on top of the Buffalo sandstone, but in a few places it is interbedded with sandstone and at one exposure southeast of Elliottsville several feet of red shale were seen below and above 20 to 25 feet of Buffalo sandstone. The best exposures of the bed lie in the southeastern part of the county in the neighborhood of Markleysburg, Gibbon Glade, Elliottsville, and Farmington. Sporadic occurrences of the shale were seen throughout the Ohiopyle Valley and west of Chestnut Ridge near Wooddale. In fact, the red shale outcrops are located in the regions where the Buffalo sandstone is well developed, but, except in the Gibbon Glade-Elliottsville area, the shale is not well developed and may in many places be missing from the section.

Cambridge limestone (Thomas or Pine Creek). This limestone lies below the Lower Bakerstown coal and is about 180 to 190 feet above the Upper Freeport coal. The limestone is of two types, one of which is a gray, massive, very hard non-fossiliferous clay limestone, whereas the other is dark, fossiliferous, massive to thin-bedded, shaly limestone. Both types occupy approximately the same horizon in the group, but they are not found together. The first type occurs in the Farmington-Elliottsville area and has been opened in many mines.

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[13] R. V. Hennen and D. B. Reger, Preston County: West Va. Geol. Surv., pp. 142-143, 1914.

[14] C. K. Swartz, The coal basins of Maryland: Maryland Geol. Surv., vol. XI, p. 59, 1922.

Names of members in lower part of Conemaugh group

Material	Fayette County	Ashley[1]	Swartz[2]	Wilmarth[3]	Campbell[4]
Sandstone	Saltsburg	Saltsburg	Saltsburg	Saltsburg	Saltsburg
Coal	Upper Bakerstown	Upper Bakerstown	Bakerstown	Upper Bakerstown	
Limestone		Albright	Albright		
Red shale	Cambridge	Cambridge	Cambridge	Cambridge	
Limestone	Woods Run	Woods Run or Cambridge	Cambridge fauna	Woods Run	
Coal	Lower Bakerstown	Thomas or Lower Bakerstown	Lower Bakerstown or Thomas	Lower Bakerstown	Hagar
Limestone	Cambridge	Thomas or Pine Creek	Thomas	Cambridge	
Red shale	Meyersdale	Meyersdale	Meyersdale	Meyersdale	
Sandstone	Buffalo	Buffalo	Buffalo	Buffalo	Buffalo

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[1] Ashley, Geo. H., Bituminous coal fields of Pennsylvania: Penna. Geol. Surv., 4th ser., Bull. M6, part I, pp. 90-91, 1928.

[2] Swartz, C. K., Distribution and stratigraphy of the Coal Measures: Maryland Geol. Surv., vol. XI, pp. 59-61, 1922.

[3] Wilmarth, M. Grace, Tentative correlation of the named geologic units of Pennsylvania (Southwestern Penna.): U. S. Geol. Surv., 1928.

[4] Campbell, M. R., U. S. Geol. Surv., Geol Atlas, Masontown-Uniontown folio (No. 82), 1902.

The limestone is approximately 2 feet thick and is separated by 12 to 18 inches of clay from an overlying coal. The second type is exposed in the Somerfield area and in a few scattered outcrops west of Chestnut Ridge. The limestone is variable from limy nodules in shale to a shaly limestone bed 1 to 2 feet thick. In some places the limy material contains fossils, whereas in others they are found only in the subjacent shale beds. Crinoid stems, brachiopods, gastropods and pelecypods were seen, but no complete collections were made.

The nomenclature dealing with the strata in this part of the Conemaugh group is confused owing to the extreme irregularity in the number and thickness of beds present in different regions. The table given herewith, it is hoped, will aid somewhat in clarifying the names as well as giving the more important equivalents for beds which bear more than one name.

Lower Bakerstown coal. A coal about 2 feet thick lies 182 feet on the average above the Upper Freeport coal in the Farmington-Elliottsville region at the southern end of the Ohiopyle Valley. The coal is fairly pure and uniform in thickness in this region, and has been opened in several country banks to mine both the coal and the underlying Cambridge limestone. Campbell (1902) called this coal the Hagar coal from the name of a hill where it is well exposed and did not attempt to correlate it with the established Conemaugh section for southwestern Pennsylvania. In the field work for this report it was correlated with the Lower Bakerstown coal of the Pittsburgh region and the Thomas coal of western Maryland.

Woods Run limestone. The Woods Run is a thin bed (up to 2 feet thick) of fossiliferous limestone which was clearly identified in the Somerfield area. It lies approximately 250 feet above the Upper Freeport coal and 50 feet above the Cambridge limestone. Crinoid stems and gastropods were seen in the limestone, but no fossils were found in the adjacent shales. The limestone was not identified in other parts of Fayette County, but there is a possibility that the limestone 180 feet above the Upper Freeport coal west of Chestnut Ridge is the Woods Run and not the Cambridge, as it is called in this report. The thinning of the strata between the Brush Creek limestone and the Saltsburg sandstone west of Chestnut Ridge places this limestone near the base of the Saltsburg sandstone and close below the Upper Bakerstown coal, so, although it may lie the same distance above the Upper Freeport coal as the Cambridge limestone east of the ridge, it might still be the equivalent of the Woods Run limestone (see the generalized Conemaugh section).

Upper Bakerstown coal. A coal lying close to the base of the Saltsburg sandstone in the northern part of Fayette County along the Fayette anticline is believed to correlate with the Upper Bakerstown. This coal is not known in the rest of the county, but may be present in places as Saltsburg sandstone float commonly masks the strata under the sandstone. The coal is 2 to 3 feet thick where seen and has been opened in country banks.

Saltsburg sandstone. The Saltsburg sandstone was named by J. J. Stevenson (1877, page 317, and 1878, page 22) from the fine exposures in Westmoreland County along Conemaugh River and Loyalhanna Creek near Saltsburg. The sandstone lies from 200 to 360 feet above the Upper Freeport coal and is 80 to 100 feet thick. It is higher above the coal in the eastern than in the western part of the county. The Saltsburg is commonly composed of sandstone and sandy shale. It is highly irregular, in some places being massive to thick-bedded sandstone, whereas in other places shale and sandy shale may compose 75 percent of the thickness. This change may be seen north of Rothrock, where a cut on Route 51 shows 30 feet of sandy clay as the upper part of the Saltsburg, whereas along a stream gulley a few hundred yards distant the horizontal equivalent is medium- to thick-bedded sandstone. The Saltsburg sandstone is most prominent in outcrop along the northern part of the Fayette anticline, where it forms extensive cliffs and boulder fields and underlies extensive flat sandy benches. Elsewhere in the county it is a well marked horizon showing sandstone float and sandy soil, but it is no more prominent than the other thick sandstones of the Conemaugh.

Pittsburgh redbeds. In many parts of southwestern Pennsylvania red shale is common directly on top of the Saltsburg sandstone. It has been named the Pittsburgh red shale from its fine exposures along the low-grade railroads at Pittsburgh. In Fayette County the shale is less prominent than at Pittsburgh and in several areas it has either been replaced by gray shales or been removed from the section by erosion. (See the Rothrock section given above.) However, in nearly all places it is possible to find traces of a few feet of red shale above the Saltsburg sandstone. Commonly less than 10 feet thick, a few exposures show 15 to 25 feet of red shale. The shale is soft and when water-soaked may become highly plastic. This characteristic makes it difficult to drill oil and gas wells through the strata in much of West Virginia and southwest Pennsylvania, and the drillers have called the shale the ''Big Red Cave.'' In building the dam at Lake Lynn on the south boundary of the county it was feared that the foundations would not be solid because they had to rest on the Ames limestone or shale and Harlem coal and clay directly above these red beds. However, the red shale proved strong enough to support the weight of the dam.

Jane Lew sandstone. A thin gray hard sandstone occurs in a few places in the Pittsburgh redbeds and has been called the Jane Lew. The detailed prospecting for the Lake Lynn dam showed the sandstone to be 8 to 10 feet thick and underlain by reddish clay shale. The sandstone was not observed elsewhere in Fayette County, but it may well be present, as very few exposures were seen which would give sufficient detail for a definite determination of a 10-foot bed of sandstone.

Ewing limestone. A limestone bed 5 to 10 feet thick and lying at the top of the Pittsburgh red shale has been called the Ewing by the Ohio geologists. This limestone was seen in two areas in Fayette

County. Several exposures along Route 51 south of Rothrock show it to be 5 feet thick and a dark, gnarly, hard stratum. Fossils were not seen, but traces of carbonized plant remains are present. In the area west of Confluence two quarries and some float mark the horizon of the Ewing, which here is similar in all respects to the exposures near Rothrock.

Harlem coal. The Harlem coal received its name from the town of Harlem, Carroll County, Ohio, where it has been mined extensively. It has in the past also been called the Crinoidal coal from the overlying limestone and the Friendsville coal from Friendsville, Garrett County, Maryland. In Fayette County the coal is known from two widely separated localities, one along the Fayette anticline in the general vicinity of Waltersburg and to the north, and the other in the Johnstown syncline east of Somerfield. The coal has been opened at both places and is a fairly pure bed 2 to 3 feet thick.

Ames limestone. The Ames or Crinoidal limestone which is such an excellent horizon marker in the region north of Fayette County, was not seen in the county. Diligent search was made for it where the Harlem coal and Ewing limestone crop out but it was not found. The places where Stevenson (1877, 1878) reported this limestone were examined but his occurrences obviously belong elsewhere in the Conemaugh group than at the Ames horizon.

Washington red shale, Berlin coal, and Birmingham red shale. The Berlin coal was not seen in Fayette County, but since there were no good exposures of this part of the Conemaugh it may be present as a thin bed. The Upper Middletown section shows the upper part of the Birmingham red shale which, together with several poor outcrops of a few feet of red shale, constitute all the exposures of this part of the Conemaugh.

Barton coal and limestone. Stevenson (1877, pages 67-68) named the coal lying immediately below the Morgantown sandstone the Barton coal from the town of Barton in the Georges Creek basin of Maryland where the coal is thick and has been mined extensively. The name Elk Lick was applied to the same coal in Somerset County at a much earlier date, but because the Somerset section was misinterpreted at that time the name has been used subsequently in many parts of Pennsylvania for several different coals and has caused much confusion. Therefore the name Barton is used in this report as it also has been in the literature for many years and has never been applied to any other coal.

The Barton coal is exposed at many places along the Fayette anticline, where it is commonly 2 feet thick and not very pure. Few country banks have been opened on the coal because of its poor quality. The best section of the Barton coal and the surrounding beds was seen south of Upper Middletown, where the Barton coal is separated by 12 feet of black shale from the overlying Morgantown sandstone. In the same exposure the Barton limestone occurs 8 feet below the coal. The limestone is 3 feet thick, dark gray, knobby and impure. It lies directly on top of the Birmingham red shale. A few other exposures show the limestone to be of much the same character throughout the anticlinal area but do not show the underlying red shale nor do they extend high enough above the limestone to show the interval to the coal. The thickness ranges between 2 and 4 feet. In the Johnstown syncline the horizon of the Barton coal and limestone is caught by the hill southwest of Somerfield but they do not crop out.

Morgantown sandstone. J. J. Stevenson named this sandstone from its fine exposures in the vicinity of Morgantown, West Virginia. The sandstone outcrops along the west flank of the Chestnut Ridge anticline and along the Fayette anticline. Small areas of it cap some of the highest hills along the Johnstown synclinal axis. The base lies 230 feet above the Saltsburg sandstone and 425 feet above the Upper Freeport coal in the area west of Chestnut Ridge. The Johnstown syncline exposures show it to be 245 feet above the Saltsburg and 525 feet above the Upper Freeport. The Morgantown sandstone is 50 to 80 feet thick in Fayette County and, although in a few localities it may all be hard sandstone, more commonly a large part of it is weak, thin-bedded sandstone and sandy shale. The sandstone is commonly medium-grained but contains rare lenses of coarse material, some of which is conglomeratic. The rock is brownish-gray when fresh but weathers deep brown. Bedding planes and joints are well developed throughout and some parts show cross-bedding. (See figure 23.)

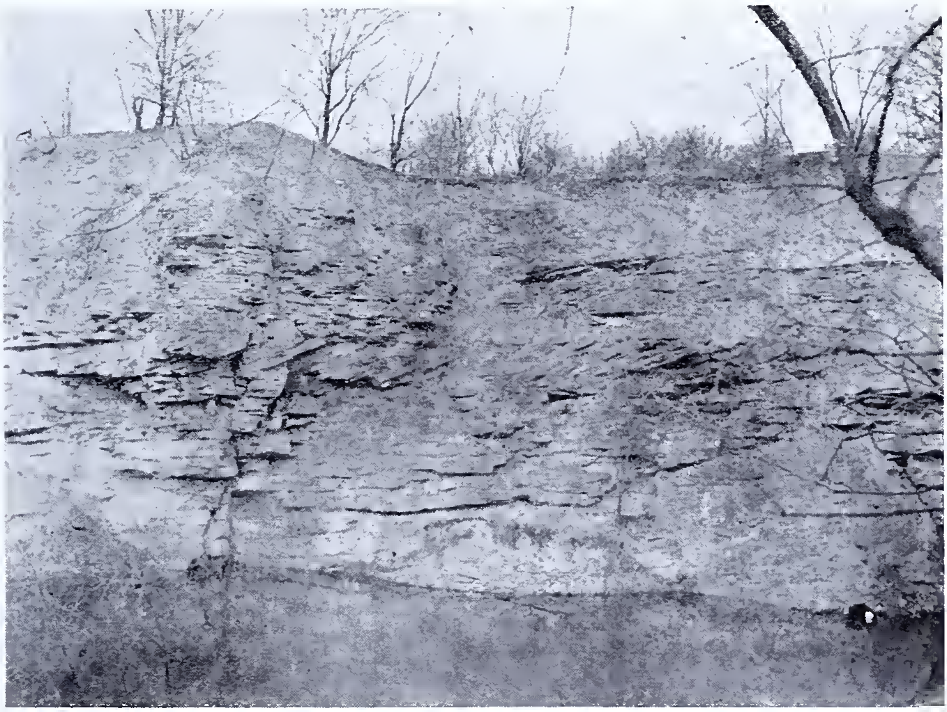

Figure 23. Morgantown sandstone, showing cross bedding.
Quarry 1 mile east of Sandy Hill on State Route 41.

Lonaconing coal and clay. The section measured northeast of Connellsville shows 20 feet of dark clay shale which contains many plant fragments and lies on top of the Morgantown sandstone and below the Clarksburg red shale. Near the top of the clay shale several lenses of poor coal up to 1 foot thick were observed. The coal lenses are inclined 10° to 15° to the major bedding of the shale and give the appearance of fore-set beds. This coal is tentatively correlated with the Lonaconing coal but it is obviously local in character.

Clarksburg limestone and red shale. The Clarksburg limestone and red shale were named by I. C. White from exposures at Clarksburg, West Virginia. They lie in the interval between the Connellsville and Morgantown sandstones and are exposed in many places in the western part of Fayette County and are recorded in several of the Upper Conemaugh sections given above. They lie 485 to 500 feet above the Upper Freeport coal and 140 to 155 feet below the Pittsburgh coal. The limestone apparently is lacking in some sections and may occur in two beds in others. In many places lime nodules in clay mark the horizon, whereas in others there are distinct limestone lenses and in the Connellsville area the limestone appears to be a single extensive bed. In the southwestern part of the county many exposures show two limestone horizons separated by about 20 feet of shale which is commonly gray, but in some places is red. This shale is correlated with the Clarksburg red bed which does not appear to be persistent in southwest Fayette but is nearly always present below the single limestone bed in the northern part of the county.

Little Clarksburg coal. This coal was named by I. C. White from its exposures at Clarksburg, West Virginia, and was called the Little Clarksburg because the Pittsburgh coal bed, which is mined there, is locally called the Clarksburg. In Fayette County the coal is fairly pure but ranges from 8 inches to 1 foot in thickness and so, although quite persistent, is not workable. In West Virginia and eastward in Somerset County and Maryland the bed is thicker but contains much clay and black slate. In Maryland it is called the Franklin or ''Dirty Nine-foot'' coal.

Connellsville sandstone. This sandstone was named by Stevenson from its fine exposures along the Youghiogheny River south of Connellsville. The sandstone lies a little more than 500 feet above the Upper Freeport coal and its top is 50 to 80 feet below the Pittsburgh coal. The thickness ranges from 50 to 80 feet and part of the sandstone in many places is replaced by sandy shale. The sandstone is present in Fayette County only west of Chestnut Ridge. In the southern part of this area it commonly is brown, hard and persistent, so that it forms cliffs along most of the stream gorges, but in the north it is variable in character and in many places the outcrop can be distinguished only by the presence of small weak sandstone float. Southward in West Virginia the sandstone is more massive and has furnished excellent building stone for bridge piers and rough walls.

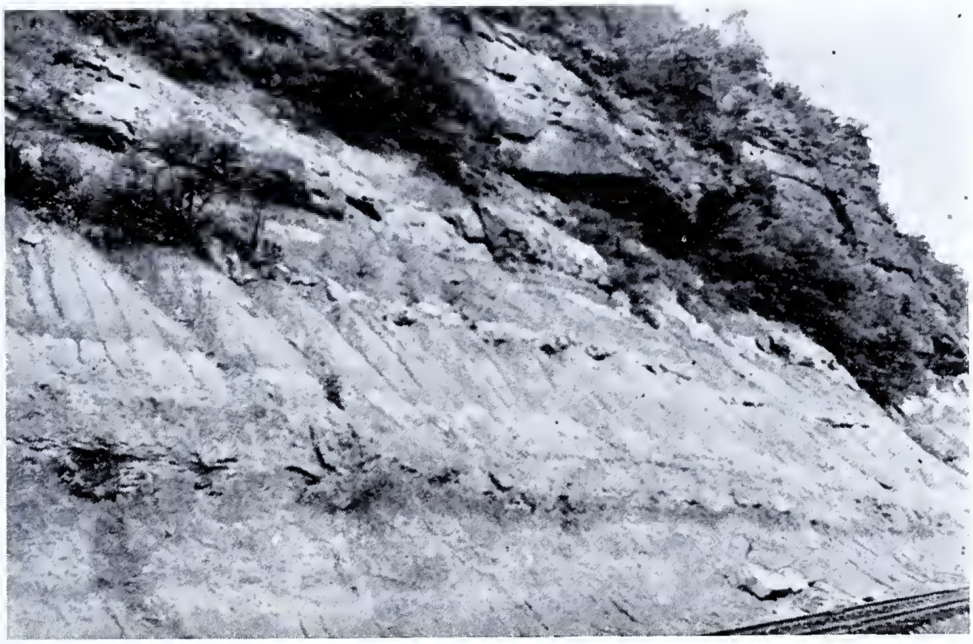

Figure 24. Connellsville sandstone and Clarksburg member.
On Western Maryland R. R. north of Dunbar Creek.

Lower Pittsburgh limestone. Only one or two exposures of this limestone were seen in Fayette County. It lies about 40 feet below the Pittsburgh coal and is 1 to 2 feet of massive impure limestone.

Little Pittsburgh coal. Like all the rest of the strata lying immediately below the Pittsburgh coal the Little Pittsburgh coal seldom crops out. This is partially due to the nature of the strata themselves but also to the extensive mining of the outcrop of the Pittsburgh seam and the dumping of the debris over the outcrops of the underlying strata. Several exposures of a 1-foot coal about 35 feet below the Pittsburgh bed well scattered throughout western Fayette County lead to the belief that the Little Pittsburgh coal, although infrequently seen, is a persistent thin bed.

Lower Pittsburgh sandstone. The Lower Pittsburgh sandstone in Fayette County commonly is an unimportant bed of weak, thin-bedded, brown shaly sandstone. It lies 20 to 40 feet below the Pittsburgh coal and is 10 to 15 feet thick in most places. However, in the vicinity of Juniataville it is 30 feet thick and massive, hard, gray sandstone is taken from several quarries for use as road stone.

Upper Pittsburgh limestone. Along Galley Run north from Broadford this limestone is well exposed about 10 feet below the Pittsburgh coal and separated from it by clay and clay shale. The limestone is hard, gray and occurs in a 2-foot bed. In places it appears to be high in iron content and might form low-grade iron ore. A few other exposures of this limestone scattered throughout the western part of the county indicate that it is not confined to the Broadford area but the thinness of the bed makes its extent difficult to determine.

MONONGAHELA GROUP

General account. The Monongahela group, formerly called the Upper Productive Coal Measures, lies between the Conemaugh and Washington groups, and is the highest part of the Pennsylvanian system. The group name comes from the Monongahela River along which the group is very well exposed. The strata consist of limestone, shale and sandstone with several beds of workable coal. The base is at the bottom of the Pittsburgh coal and the top at the top of the Waynesburg coal. In this report the group will be treated as a whole and has been mapped as a unit. Many of the individual beds have been named because of their economic importance or their prominence in the field. They will be discussed below.

Two generalized sections and the lower part of a third are given because the variation in the Monongahela group is so great between the Uniontown and Lambert synclines and in the southwest corner of the county that one section would not serve to show the strata accurately. Many complete sections and numerous partial sections show the variation in individual beds more perfectly in this group than in any other. This variation is extreme, and, although the composite sections present an average picture for parts of the county, individual measured sections may differ greatly from them. Not only are some of the beds lacking in places but also the intervals between named beds may differ considerably as well as the thickness of the beds themselves.

Generalized sections of the Monongahela group.

Name and character of strata	Thickness (in feet)			Above base of Pittsburgh coal (in feet)		
		Average		Uniontown basin		Lambert syncline
	Variation	Uniontown basin	Lambert syncline	North of Smithfield	South end	
Waynesburg coal (top)	1–9	3	5½	350		390
Gilboy sandstone	0–20	10	10	335		370
Little Waynesburg coal	0– 1½	0½	1	330		355
Upper Waynesburg limestone	0–13		6			345
sandstone	0–25	20	10	300		335
Lower Waynesburg limestone	10–25		15			315
Uniontown sandstone	0–20	5	10	290		305
Uniontown coal	0– 3½	1	2	280		295
Uniontown limestone	5–30	10	15	275		265
Arnoldsburg sandstone	0–20	5	10	270		255
Upper Benwood limestone	20–70	40	50	230		205
Benwood coal and black shale	0– 5	2	2	225		200
Lower Benwood limestone	15–70	50	50	170		150
Upper Sewickley coal	0– 4	2	1½	165	?	148
Sewickley sandstone	10–35	20	20	140	150	121
Lower Sewickley coal	½– 6	5	1	135	140	120
Fishpot limestone	5–30	15	20	110	120	95
Redstone coal	½– 5	2	1	85	75	75
Redstone limestone	5–20	15	5	65	60	65
Upper Pittsburgh sandstone	0–30	15	15	50		40
Pittsburgh Rider coal	0– 5	1	1½	45	45	35
Pittsburgh sandstone	0–35	20	15	15	10	15
Pittsburgh coal	7–16	9	8½	0	0	0

Areal distribution. The Monongahela group is present only in the western part of Fayette County. It lies in two areas elongated northeast and southwest. The eastern of these areas is the Uniontown Basin which parallels Chestnut Ridge and lies 3 to 6 miles west of it. Monongahela strata crop out around the edges of the basin but are covered by rocks of Permian age in the center. North of the Youghiogheny River only the lower Monongahela strata are preserved in the hills and Upper Conemaugh rocks are exposed along the larger streams. From the river southwest as far as Uniontown the Monongahela strata crop out in two belts along the sides of the basin. Southwest of Uniontown the Washington group caps only the highest hills and the surface of the basin as far southwest as York Run is underlain largely by Monongahela strata. West and southwest of York Run Monongahela strata occur only in the higher hills; the Conemaugh underlies the valleys.

The western area of the Monongahela rocks is separated from the eastern by the Fayette anticline. It lies along the Lambert syncline, the Brownsville anticline, and the Port Royal syncline, and will hereafter be spoken of as the Klondike district. A continuous belt of Monongahela strata extends along the eastern side of the Lambert syncline. Starting at Masontown it passes through New Salem, Searight, and Perryopolis, and crosses into Westmoreland County near Wickhaven. In the center of the Lambert syncline the surface is underlain by the Washington and Greene groups except along Redstone Creek and a few smaller creeks to the north where the Monongahela strata are exposed in the valleys. Along the Brownsville anticline the low hills and the valleys are underlain by Monongahela rocks whereas the high hills are capped by Washington strata.

Measured sections of the Monongahela. Nowhere in the county can a complete section of the Monongahela group be measured on the surface but along both the Uniontown and Lambert synclines mine shafts have been sunk entirely through the group and shaft sections as well as a few diamond drill sections are available. Besides these it has been possible to measure many partial sections on the surface around the edges of the synclines where no records of shafts or diamond drill holes are available. The best and most representative of these sections will be given here. Attention will be given first to Monongahela sections in the Klondike district and then to the area along the Uniontown syncline. The Brier Hill, Sarah, Filbert, Ralph, Edenborn, Ronco, Standard, Leisenring, Oliver and Leith shaft sections are published by the courtesy of the H. C. Frick Coal & Coke Company.

Upper Monongahela and Washington section 1½ miles southwest of Whitsett

Thickness Feet	Character of beds	Name	Above Pittsburgh coal Feet (estimated)
	Concealed		
8	Sandstone	(Waynesburg)	405
13	Concealed		
2+	Coal	(Waynesburg)	390
35	Concealed		
5	Sandstone	(Gilboy)	350
4	Shale		
1	Coal	(Little Waynesburg)	345
10	Limestone	(Waynesburg)	335
	Concealed		

Monongahela section in gully west of Whitsett

Thickness Feet	Character of beds	Name	Above Pittsburgh coal (estimated) Feet
	Concealed		
10	Sandstone	(Gilboy)	350
35	Concealed		
20	Sandstone, shaly	(Uniontown)	295
1	Coal bloom	(Uniontown)	294
34	Shale and concealed		
15	Limestone	(Upper Benwood)	245
35	Sandstone and shale		210
55	Massive limestone with interbedded shale	(Lower Benwood)	155
2	Coal	(Sewickley)	153
58	Limestone and shale	(Fishpot)	95
5	Coal	(Redstone)	90
15	Limestone	(Redstone)	75
67	Concealed with sandstone and shale		
8	Coal	(Pittsburgh)	0

These two partial sections of the Monongahela group fit together and give a complete section for the group in the northwestern part of the county. The exposures are not sufficiently complete to record individual beds but they give a general view of the group and its named members.

Monongahela section in the Sarah air shaft

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
23	4	Sandstone	(Waynesburg)	393	3
			(Horizon Waynesburg coal)		
4	4	Hard shale			
24	4	Sandstone (coarse)	(Gilboy)	364	7
7	0	Sandy shale			
7	8	Sandstone			
0	7	Shale			
10	7	Sandstone			
2	9	Hard shale			
9	0	Sandstone			
0	7	Shale			
11	1	Sandstone			
2	9	Shale			
3	0	Sandstone			
4	6	Gray shale			
3	2	Sandstone			
0	9	Hard shale			
5	7	Soft shale			
2	10	Clay			
0	3	Coal	(Uniontown)	292	6
2	7	Black shale			
3	11	Gray shale			
3	6	Hard shale			
6	9	Limestone	(Uniontown)	275	9
1	6	Hard shale			
9	0	Sandy shale	(Arnoldsburg)	265	3
3	6	Limestone	(Upper Benwood)	204	0
0	3	Shale			
3	0	Limestone			
0	3	Shale			
2	6	Limestone			
2	2	Shale and clay			
11	0	Blue limestone			
4	5	Gray shale			
0	10	Soft blue stone			
11	10	Limestone and shale			
3	1	Clay			
8	6	Yellow limestone			
4	0	Limestone and shale			
0	6	Soft blue stone			
5	0	Limestone and shale			
0	5	Soft blue stone			

Monongahela section in the Sarah air shaft—Continued

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
1	5	Black shale	(Benwood coal)	202	7
10	8	Limestone	(Lower Benwood)	151	5
0	8	Shale			
12	5	Limestone			
6	8	Slate and limestone			
12	0	Limestone			
8	9	Slate and limestone			
4	11	Clay			
0	6	Coal	(Upper Sewickley)	146	6
19	1	Sandstone	(Sewickley)	127	5
0	8	Dark shale	(Lower Sewickley)	126	9
8	0	Black limestone	(Fishpot)	99	5
0	10	Clay			
8	10	Dark limestone			
1	0	Clay			
8	8	Gray limestone			
8	6	Soft shale			
10	0	Clay			
7	3	Soft shale and limestone	(Redstone)	73	8
2	3	Sandstone			
4	0	Gray shale			
7	2	Dark shale			
24	10	Sandstone	(Upper Pittsburgh)	35	5
0	4	Coal	(Pittsburgh Rider)	35	1
25	8	Sandstone	(Pittsburgh)	9	5
0	7	Roof coal			
0	10	Slate			
8	0	Coal	(Pittsburgh)	0	0

This section indicates the character of the Monongahela group west of the Brownsville anticline in the area where the Monongahela River describes a large meander around Luzerne Township.

Monongahela section in the Brier Hill shaft

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
13	8	Sandstone	(Waynesburg)		
5	4	Coal and slate	(Waynesburg—top)	370	10
12		Sandstone	(Gilboy)	353	6
2	1	Plastic clay			
3	6	Black shale	(Little Waynesburg coal)	347	11
4		Limestone	(Upper Waynesburg)	337	3
1	4	Black shale			
5	4	Limestone and clay			
4		Sandstone			
9	6	Sandy shale			
2		Sandstone			
1	6	Limestone	(Lower Waynesburg)	311	9
7	6	Plastic clay			
1		Limestone			
12		Plastic clay			
8		Sandstone	(Uniontown)	291	9
2		Shale			
4	2	Coal and slate	(Uniontown)	285	7
15	10	Sandy shale			
2		Plastic clay			
8	10	Limestone	(Uniontown)	268	11
1		Plastic clay			
6	11	Sandstone	(Arnoldsburg)	261	0
5	11	Limestone	(Upper Benwood)	212	7
1	6	Black shale			
19		Limestone			
1		Plastic clay			
12		Sandstone			
3		White shale			
6		Limestone			
3	6	Black shale	(Benwood coal)	209	1
5	0	Limestone	(Lower Benwood)	142	1
1	0	Clay			
4	0	Limestone			
1	0	Clay			
14	0	Limestone			
7	9	Sandstone			
26	9	Limestone			
2	4	Plastic clay			
3	5	Coal and slate	(Upper Sewickley)	136	4
16	7	Sandstone	(Sewickley)	119	9
18	6	Black shale			
1		Plastic clay			
24	3	Limestone	(Fishpot)	76	0
1	6	Blue clay			
19	11	Plastic clay			
8		Limestone	(Redstone)	40	7
1		Clay			
5		Black limestone			
7	10	Coal and slate	(Pittsburgh Rider)	30	9
4	6	Coal and slate	(Pittsburgh Rider)	30	9
3		Blue shale			
	6	Limestone			
14	5	Black shale			
1	4	Plastic clay			
7		Coal	(Pittsburgh)	0	0

This section is located at the south end of the deepest part of the Lambert syncline.

Monongahela section in the Filbert hoisting shaft

Thickness Ft.	Thickness in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	Above base of Pittsburgh coal in.
		Plastic clay			
3	0	Coal			
1	0	Binder	(Waynesburg (top))	401	5
3	0	Coal			
12	0	Gray shale			
1	0	Coal	(Little Waynesburg)	381	5
18	9	Gray shale and clay			
8	0	Black shale			
3	0	Limestone	(Upper Waynesburg)	351	8
3	0	Shale			
21	0	Limestone	(Lower Waynesburg)	327	8
5	8	Shale			
7	6	Limestone			
0	6	Coal			
2	0	Clay	(Uniontown)	311	6
0	6	Coal			
19	6	Gray shale and clay			
8		Limestone	(Uniontown (split))	284	0
2	3	Plastic clay			
8	6	Gray shale			
2		Plastic clay			
17		Limestone	(Uniontown)	254	3
5		Sandstone	(Arnoldsburg)	249	3
6		Limestone	(Upper Benwood)	219	9
8		Shale			
2		Plastic clay			
13	6	Limestone			
5		Plastic clay			
2	6	Coal	(Benwood)	212	3
25		Limestone			
10		Shale	(Lower Benwood)	155	3
22		Limestone			
5	6	Shale and clay			
1	6	Coal	(Upper Sewickley)	148	3
7		Gray shale			
20		Black shale			
5		Limestone			
1	6	Plastic clay	(Fishpot)	106	3
8	6	Limestone			
35	6	Plastic clay			
5		Gray shale and clay			
9		Gray shale			
8		Sandstone	(Upper Pittsburgh)	48	9
3		Black shale			
	8	Coal	(Pittsburgh Rider)	45	1
5	4	Black shale			
19		Brown sandstone	(Pittsburgh)	20	9
9		Brown shale			
1		Roof coal			
1		Slate			
9	9	Coal	(Pittsburgh)	0	0

Mononyahela section in Ralph air shaft

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
14		Shale			
1	6	Coal	(Waynesburg (top))	366	8
1		Slate			
1	6	Coal			
3	6	Slate			
2		Coal			
9	6	Shale			
16		Sandstone	(Gilboy)	331	8
1		Shale			
6		Limestone	(Upper Waynesburg)	324	8
1	6	Coal	(Little Waynesburg)	323	2
3		Limestone	(Upper Waynesburg)	320	2
17		Slate			
9		Limestone	(Lower Waynesburg)	286	2
5		Shale			
3		Limestone			
3	6	Sandstone	(Uniontown)	278	8
8	6	Shale			
1	6	Coal	(Uniontown)	268	8
3	6	Limestone	(Uniontown)	265	2
5		Shale			
7		Sandstone	(Arnoldsburg)	253	2
12		Limestone	(Benwood limestone) (undivided)	134	10
1	6	Shale			
3		Sandstone			
22	6	Limestone			
15		Limestone and shale			
4		Shale			
21	2	Limestone			
6	3	Limestone and shale			
7	3	Sandstone			
7	8	Limestone			
10	1	Limestone and shale			
2	5	Yellow limestone			
5	6	Limestone and shale			
1	11	Plastic clay			
	6	Coal	(Upper Sewickley)	132	5
13	9	Gray shale			
10		Black shale			
7	9	Gray shale			
6		Limestone	(Fishpot)	94	11
1	1	Plastic clay			
1	1	Black shale			
9	4	Limestone	(Fishpot ?)		
6	6	Shale and limestone			
4		Black shale	(Redstone coal)	72	11
3	9	Plastic clay			
2	9	Shale and limestone			
7	5	Limestone	(Redstone)	59	0
2	3	Soft shale			
17	1	Gray shale with sandstone lenses	(Upper Pittsburgh)	39	8
2	7	Gray shale			
6	2	Black shale			
1	8	Coal	(Pittsburgh Rider)	26	9
2	2	Slate			
0	4	Coal			
17	1	Gray shale with sandstone lenses			
0	3	Roof coal			
0	4	Slate			
8	3	Coal	(Pittsburgh)	0	0

Monongahela section in Edenborn shaft

Thickness Ft.	in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	in.
20	6	Shale			
6		Coal	(Waynesburg (top))	398	6
3		Plastic clay			
5		Sandstone	(Gilboy)	384	6
15		White shale			
4		Black shale	(Little Waynesburg coal)	365	6
3		Limestone	(Upper Waynesburg)	362	6
6		Sandstone			
4		Plastic clay			
6		Clay shale			
15		Limestone (streaked with clay)	(Lower Waynesburg)	331	6
7		Sandstone	(Uniontown)	324	6
14		Clay shale			
3		Limestone			
2		Coal	(Uniontown)	305	6
17		Clay shale			
8		Sandstone			
3		Shale			
14		Limestone	(Uniontown)	263	6
8		Sandstone	(Arnoldsburg)	255	6
3		White shale			
3		Black shale			
1		Limestone			
3		Black shale			
4		Limestone			
3		Sandstone			
23		Limestone (streaked with clay)	(Upper Benwood)	215	6
1		Plastic clay			
5		Shale			
19		Limestone	(Lower Benwood)	157	6
2		Sandstone			
3		Gray shale			
28		Limestone			
4		Plastic clay			
1	4	Shale			
	8	Coal	(Upper Sewickley)	151	6
18		Shale			
12		Sandstone	(Sewickley)	121	6
9		Limestone			
1		Clay			
11		Limestone	(Fishpot)	92	6
10		Fire clay			
2		Sandstone			
7		Plastic clay			
1		Coal	(Redstone)	72	6
3		Plastic clay			
12		Limestone	(Redstone)	57	6
2		Clay shale			
5		Shale			
10		Sandstone	(Upper Pittsburgh)	40	6
10		Shale			
19	6	Sandstone	(Pittsburgh)	11	0
2		Roof coal			
1		Slate			
8		Coal	(Pittsburgh)	0	0

Lower Monongahela section in Ronco No. 1 shaft

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
34	6	Surface clay			
4		Blue shale	(Lower Benwood) (in part)	162	11
1	6	Blue limestone			
4	9	Black shale			
6	9	Limestone			
1	7	Blue shale			
1	5	Limestone			
9	9	Blue clay			
2	11	Black shale			
2	5	Coal	(Upper Sewickley)	147	10
5	7	Plastic clay			
5	9	Gray shale			
32		Sandstone	(Sewickley)	104	6
3	2	Black shale	(Lower Sewickley coal)	101	4
4	3	Limestone			
4	9	Shale and limestone	(Fishpot)	92	4
27	9	Plastic clay			
1		Shale			
4		Coal	(Redstone)	59	7
12	9	Limestone	(Redstone)	46	10
10	3	Plastic clay			
3	6	Black shale	(Pittsburgh Rider coal)	33	1
13	3	Gray shale			
2		Sandstone	(Pittsburgh)	15	0
1	10	Black shale			
1		Sandstone			
2		Black shale			
2	1	Roof coal			
	3	Clay			
1	6	Slate			
1	3	Clay shale			
7	11	Coal	(Pittsburgh)	0	0

The representative Monongahela sections given above show that in general the character and succession of the rock types remain the same throughout the Klondike area, although the actual thickness and distance above the base of any member may vary considerably. There is a marked difference, however, when they are compared with the sections in the Uniontown syncline which follow.

Monongahela section in the Standard No. 2 shaft

Thickness Feet	Character of beds	Name	Above base of Pittsburgh coal Feet
	Surface		
27	Limy clay	(Uniontown)	273
4	Limestone		
4	Sandstone		
28	Gray shale	(Fulton shale)	
3	Sandstone		
2	Gray shale	(Arnoldsburg sandstone)	234
2	Sandstone		
52	Limestone	(Benwood)	182
18	Gray shale		
3	Black shale		
2	Coal	(Upper Sewickley)	159
22	Sandstone	(Sewickley)	137
2	Black shale	(Lower Sewickley)	135
6	Limestone	(Fishpot)	129
45	Gray shale		
2	Coal	(Redstone)	82
3	Black shale		
27	Gray shale		
33	Black shale		
5	Dark sandstone	(Pittsburgh)	14
5	Black shale		
9	Coal	(Pittsburgh)	0

This section lies in Westmoreland County but it is given here as no other section is obtainable which represents the northern end of the Uniontown syncline in Fayette County.

Monongahela section at the Leisenring No. 1 shaft

Thickness		Character of beds	Name	Above base of Pittsburgh coal	
Ft.	in.			Ft.	in.
15		Variegated clay			
3		Sand and boulders	(Carmichaels)		
		Unconformity			
11		Black shale			
3	4	Coal	(Waynesburg (top))	340	11
3	8	Black shale			
15		Limestone with shale partings	(Waynesburg)	318	11
1		Plastic clay			
10		Clay shale			
4		Black shale			
3		Brown limestone	?	290	11
	6	Black shale			
4	6	Brown limestone			
	2	Shale			
4	10	Brown limestone			
2		Black shale			
	6	Plastic clay			
2	6	Black shale			
3		Light gray sandstone			
11		Sandstone and shale	(Uniontown)	269	11
2		Light gray sandstone			
7		Black shale	(Uniontown coal ?)	262	11
3		Limestone and black shale			
2		White limestone	(Uniontown)	249	11
8		Brown limestone with shale partings			
8		Gray sandstone	(Arnoldsburg)	241	11
5		Black shale			
5		Limestone	(Benwood)	178	11
4		Plastic clay			
20		Limestone with shale partings			
3		Clay			
26		Limestone with shale partings			
5		Clay			
2	3	Coal	(Upper Sewickley)	171	8
30	9	Dark gray sandstone	(Sewickley)	140	11
	6	Coal	(Middle Sewickley ?)	140	5
7	6	Limestone with shale partings	?	132	11
8		Clay shale			
2		Coal	(Lower Sewickley)	122	11
14		Limestone with shale partings	(Fishpot)	108	11
14		Plastic clay			
2		Limestone			
2		Plastic clay			
5		Dark shale			
5		Black shale			
	8	Coal and bone	(Redstone)	80	3
11		Brown limestone	(Redstone)	69	3
12		Shaly sandstone	(Upper Pittsburgh)	52	3
5		Flaggy sandstone			
11		Sandy shale			
5		Shale			
1		Coal	(Pittsburgh Rider)	35	3
21		Dark sandy shale			
5		Roof coal and slate			
	3	Sandstone			
9		Coal	(Pittsburgh)	0	0

Monongahela section at Leisenring No. 2 air shaft

Thickness Ft.	Thickness in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	Above base of Pittsburgh coal in.
		Sandstone	(Waynesburg)		
3	6	Coal	(Waynesburg (top))	336	10
1		Black shale			
9		Limestone	(Waynesburg)	323	4
4		Plastic clay			
7		Dark sandstone	(Uniontown)	312	4
7	2	Dark gray shale			
3		Black shale			
13		Limestone	(Uniontown)	289	2
10	6	Sandstone			
7	8	Sandstone and shale	(Arnoldsburg)	263	4
1	6	Black shale			
6	2	Dark hard sandstone			
6		Clay shale			
11	4	Limestone	(Upper Benwood)	233	0
4		Plastic clay			
9		Limestone and shale			
3		Soft blocky slate	(Benwood coal ?)	230	0
6		Buff limestone	(Lower Benwood limestone)	171	0
4		Dark gray shale			
7	2	Dark limestone			
13		Soft plastic clay			
6		Limestone and shale			
1		Plastic clay			
12	6	Limestone			
	6	Dark gray shale			
4	6	Buff limestone			
	10	Black shale			
3	6	Limestone			
8	2	Shale, limestone and coal			
1	6	Coal and black shale	(Upper Sewickley)	161	4
10	6	Dark shale			
3		Black shale		147	10
12		Limestone and shale		135	10
15		Gray shale			
2		Coal	(Lower Sewickley)	118	10
	10	Shale			
14		Impure limestone	(Fishpot)	104	0
2		Iron ore			
10		Plastic clay			
2	5	Black shale			
1	6	Coal	(Redstone)	88	1
13		Limestone	(Redstone)	75	1
23	1	Black shale			
21		Gray shale			
4		Sandstone	(Pittsburgh)	27	0
13		Shale			
2		Coal and slate			
3		Black shale	(Pittsburgh)	0	0
9		Coal			

Monongahela section at Leisenring No. 3 shaft

Thickness Ft.	in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	in.
		Sandstone	(Waynesburg)		
		Clay shale			
3	4	Coal	(Waynesburg (top))	339	3
2	7	Black limestone			
11	6	Limestone	(Waynesburg)	315	4
0	6	Clay			
3	0	Yellow limestone			
0	6	Clay			
2	0	Yellow limestone			
1	0	Clay			
6	4	Buff sandstone	(Uniontown)	308	0
2	6	Dark shale			
15		Limestone	(Uniontown)	290	6
3	4	Sandstone	(Arnoldsburg)	287	2
18		Limestone	(Upper Benwood)	246	11
1	6	Plastic clay			
20	9	Limestone			
6	4	Sandstone	(Benwood)	240	7
2	6	Black shale	(Benwood coal ?)	238	1
25		Limestone	(Lower Benwood)	180	7
3		Plastic clay			
29	6	Limestone			
3	6	Plastic clay			
	5	Coal	(Upper Sewickley)	176	8
6	7	Clay shale			
25		Sandstone	(Sewickley)	145	1
1		Coal	(Middle Sewickley)	144	1
18		Clay shale			
	3	Coal	(Lower Sewickley)	125	8
17		Limestone	(Fishpot)	108	8
20		Sandstone			
2	10	Coal	(Redstone)	85	10
18		Limestone	(Redstone)	67	10
21		Sandstone	(Upper Pittsburgh)	46	10
1	3	Coal	(Pittsburgh Rider)	45	7
23		Sandstone	(Pittsburgh)	22	7
3		Dark shale			
5		Sandstone	(Pittsburgh)	14	0
2		Dark shale			
3		Black shale			
9		Coal	(Pittsburgh)	0	0

Monongahela section in Oliver No. 1 shaft

Thickness Ft.	Thickness in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	Above base of Pittsburgh coal in.
35	6	Clay shale			
3	4	Coal and slate	(Waynesburg (top))	352	9
3		Dark buff limestone	(Waynesburg)	336	5
10		White hard limestone			
11	6	Plastic clay			
5		Shale and sandstone	(Uniontown)	308	11
11		Sandstone			
4		Brown limestone	(Uniontown)	279	11
3		White limestone			
6		Plastic clay			
2	6	Clay shale			
3		Brown limestone			
10	6	White limestone			
5		Clay shale			
4	6	Brown shale			
9	4	Impure limestone	(Upper Benwood)	253	5
7	8	Dark limestone			
4		Dark sandstone	(Benwood)	249	5
2		Black shale			
20		Limestone and clay	(Lower Benwood)	179	5
6		Clay, shale and iron ore			
11		Clay shale			
6		Black limestone			
25		Hard, gray limestone			
1	8	Plastic clay			
	4	Coal	(Upper Sewickley)	177	5
32		Sandstone		145	5
1		Coal	(Lower Sewickley)	144	5
2		Dark plastic clay			
8		Dark limestone	(Fishpot)	134 119	5 5
2	6	Light plastic clay			
12	6	Limestone with clay partings			
4		Blue clay			
17		Plastic clay			
7	4	Clay shale			
1		Black shale			
2	6	Coal and slate	(Redstone)	87	5
2		Plastic clay			
9		Dark limestone	(Redstone)	76	5
1		Plastic clay			
18		Sandstone	(Upper Pittsburgh)	57	5
6		Black shale	(Pittsburgh Rider ?)	51	5
17		Sandstone and shale	(Pittsburgh)	15	10
18	7	Sandstone and black shale			
3		Shale			
2	10	Coal and slate			
9		Coal	(Pittsburgh)	0	0

Monongahela section in the Leith shaft

Thickness Ft.	in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	in.
1		Surface clay			
11		Gravel			
4	2	Plastic clay			
	10	Shale			
1	2	Shale and brown limestone	(Waynesburg)	275	4
6	3	Light limestone			
4	2	Dark brown limestone			
	8	Black shale			
1	8	Iron ore			
10	1	Sandstone and clay	(Uniontown)	254	8
	3	Iron ore			
4	6	Dark shale			
3	6	Dark sandstone			
4	6	Coal	(Uniontown)	251	2
8	9	Brown limestone	(Upper Benwood)	223	10
2	7	Variegated clay			
4	6	Dark limestone			
1	6	Clay			
1	3	Blue limestone			
	6	Clay			
2	6	Dark brown limestone			
	3	Clay			
4	6	Brown limestone			
21	3	Sandstone	(Lower Benwood)	202	7
	3	Clay			
6	6	Black shale			
4	6	Brown limestone			
18		Limestone	(Lower Benwood)	173	4
2	6	Variegated clay			
4	6	Dark shale			
2	6	Black shale			
5	3	Coal	(Sewickley)	158	7
2	3	Fire clay			
2		Dark limestone			
10	6	Dark sandstone	(Sewickley)	143	10
24	6	Impure limestone	(Fishpot)	119	4
10		Plastic clay			
2		Sandstone			
12		Gray shale			
2		Black shale			
3		Coal	(Redstone)	87	9
	3	Clay shale			
2	4	Coal			
1	3	Shale			
12	6	Limestone	(Redstone)	74	0
24		Gray shale			
1		Coal	(Pittsburgh Rider)	49	0
15	6	Limestone			
12		Sandstone	(Pittsburgh)	21	6
12	6	Black shale and coal			
9		Coal	(Pittsburgh)	0	0

The reported section in the Leith shaft contains several members that make a detailed correlation somewhat difficult. A limestone bed 15 feet 6 inches thick is reported to underlie a one-foot-thick coal bed that is only 49 feet above the base of the formation. This interval fits the normal interval to the Pittsburgh Rider coal observed and reported at other localities in the Uniontown basin. However, the underlying limestone raises doubt as to whether the coal and limestone beds could correlate possibly with the Redstone members. However, the limestone was not observed or reported elsewhere in the vicinity or in the Uniontown basin so that it evidently has either a very local occurrence or is reported incorrectly. These facts, plus an interval of only 49 feet to the base of the Pittsburgh coal, indicate that the coal bed in question probably correlates with the Pittsburgh Rider coal as shown in the preceding section. With this correlation, the coal bed lying 87 feet 9 inches above the base of the formation ties in very well to the Redstone coal of nearby sections and the coal bed 158 feet 7 inches above the Pittsburgh bed ties to the Sewickley coal. A fourth coal bed in the Leith section, lying 251 feet above the base of the formation, does not correlate directly with any other observed or reported bed in the basin. This coal must have a very local occurrence as it was not observed or reported elsewhere in the vicinity. Its most probable correlation is with the Uniontown coal bed on which the nearest observations are located in western Dunbar Township where it lies 290 feet above the base of the Pittsburgh coal. After the coal beds of the Leith section are correlated, the intervening strata tie directly to recognized members in the nearby sections.

Monongahela section in Fancy Hill Coal Company's drill hole No. 25

Thickness Ft.	Thickness in.	Character of beds	Name	Above base of Pittsburgh coal Ft.	Above base of Pittsburgh coal in.
11	6	Surface			
10		Sandstone and mud	(Sewickley)	167	6
11	6	Soft black shale			
4		Coal	(Sewickley)	152	0
5	6	Plastic clay			
9	7	Sandy shale and clay			
2	8	Black shale			
8	0	Limestone	(Fishpot)	126	3
16		Sandy clay			
10	8	Sandy shale			
17	7	Black shale			
3	7	Coal	(Redstone)	78	5
1	5	Plastic clay			
16	8	Limestone	(Redstone)	60	4
3	10	Dark sandy shale			
1	6	Black shale			
	10	Coal	(Pittsburgh Rider)	54	2
	6	Sandy shale			
	3	Sandstone			
	10	Black shale			
	8	Sandy shale			
	5	Sandstone			
	6	Sandy shale			
13	6	Sandstone			
1	11	Black shale	(Pittsburgh)	12	10
15	10	Sandstone			
	2	Sandy shale			
1	5	Sandstone			
	2	Black shale			
1		Sandstone			
3		Shale			
1	2	Sandstone			
4	10	Black shale			
8		Coal	(Pittsburgh)	0	0

The Fancy Hill bore hole is located near Lake Lynn and shows the Lower Monongahela section in the extreme southwestern part of the Uniontown basin. It is published by courtesy of the Fancy Hill Coal Company.

The representative Monongahela sections given above show that in general the character and succession of rock types remain much the same throughout the Uniontown basin, although the actual thickness of any member and its distance above the Pittsburgh coal may vary considerably. In the extreme southern part of the basin the sections show only the lower part of the Monongahela which is thicker there than in the central part of the basin. Comparison with the Monongahela section in the Brownsville area, however, shows minor differences in sequence as well as in thickness. They will be discussed in the following general descriptions of the stratigraphy of the members of the Monongahela formation.

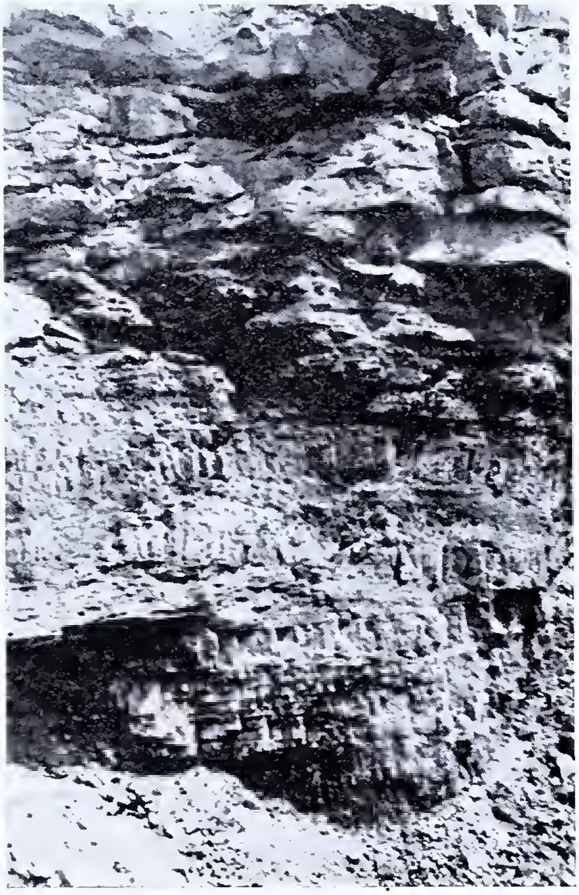

Figure 25. Pittsburgh sandstone, roof coal, and main coal.

Stripping 1 mile north of Point Marion on Route 119. Only the upper part of the main coal is shown. Just above the dark overhang on the left is the draw slate, then roof coal up to the sandstone.

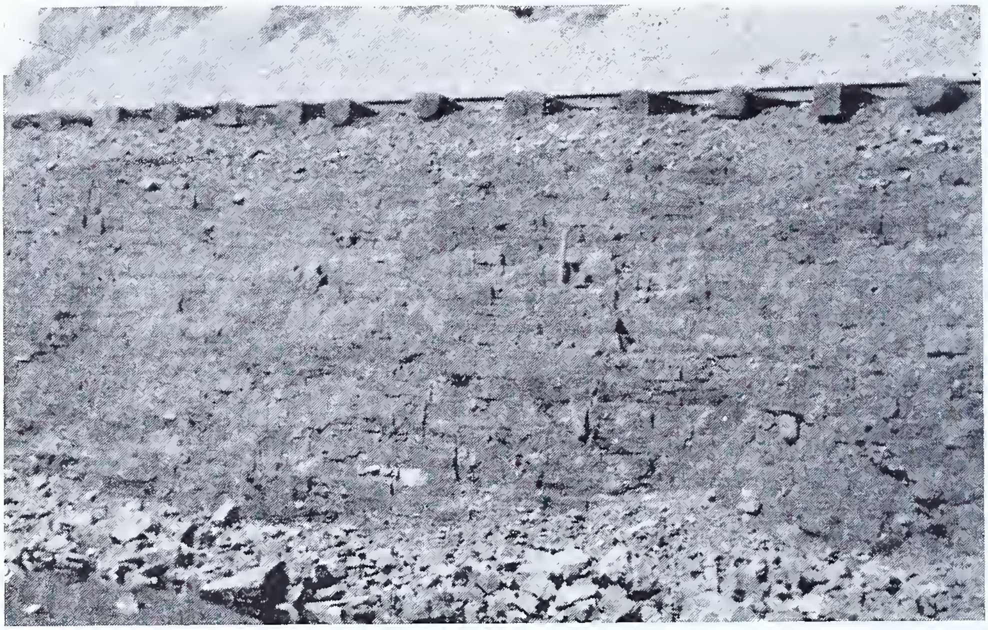

Figure 26. Pittsburgh coal at Leckrone stripping 2 miles southeast of Masontown.

Pittsburgh coal bed. The Pittsburgh coal is one of the most continuous and least variable beds in the Coal Measures of Fayette County. Therefore it is easily identifiable and because its thickness and economic importance make it prominent in outcrop, it is an excellent horizon marker. A detailed description of the bed is given in the sections on coal resources under the discussions of geology by townships and here a general description only will be given. The main coal lies under the roof division which is composed of variable thin coals interbedded with black shale. In thickness the roof division is extremely variable, ranging from 0 to 7 feet. The main division lying below the roof coal and main clay parting is remarkably clean coal containing usually two very thin shale binders. The thickness ranges from 7 to 10 feet except in the southwestern corner of the county where sandstone has been found locally cutting down into the coal and in a few places completely through it. This phenomenon, known locally as "sandstone dikes," is described in detail under the discussion on Nicholson and Springhill townships.

Pittsburgh sandstone. The Pittsburgh sandstone lies above the Pittsburgh coal bed and is commonly separated from it by a variable thickness of dark shale. A period of erosion preceded the deposition of the sandstone which in a few places has removed the intervening shale so that the sandstone rests directly on the main division of the coal. In other places the sandstone is completely lacking from the section. When present the sandstone ranges from 2 to 35 feet thick. It is a medium to hard sandstone, commonly thin to medium bedded, but in a few places it becomes heavy bedded and is suitable for quarrying. The color is dark and it contains small thin lenses of coal, as well as a small amount of limonite. The best exposures are in quarries at Elm Grove, Franklin Township, and in the Pittsburgh coal strippings southeast of Masontown and north of Point Marion.

Pittsburgh Rider coal. The Pittsburgh Rider coal is a thin bed of coal lying 35 to 55 feet above the base of the Pittsburgh coal. It is quite irregular in thickness, ranging from 6 inches to 3 feet where present, and not appearing at all in many sections. Where the coal is absent a black carbonaceous shale generally marks the horizon. This coal and the associated shale separate the Upper Pittsburgh and the Pittsburgh sandstones.

Upper Pittsburgh sandstone. Lying above the Pittsburgh Rider coal which separates it from the Pittsburgh sandstone, the Upper Pittsburgh sandstone is similar in most respects to the underlying sandstone. It ranges from 0 to 30 feet in thickness and its base lies 40 to 60 feet above the Pittsburgh coal.

Redstone limestone. The Redstone limestone received its name from the overlying Redstone coal. It is the lowest persistent limestone of the Monongahela group, but in the Leith shaft section where the correlation of the beds is somewhat doubtful there may be a local limestone below it. The Redstone limestone is composed of hard massive beds 1 to 2 feet thick, which in places are separated by limy clay shale partings. The stone is homogeneous, light to dark gray in color, hard, and breaks with a conchoidal fracture. It ranges from 0 to 20 feet thick, and averages 5 feet in the Klondike district and 15 feet in the Uniontown-Connellsville basin. It lies 65 to 70 feet above the base of the Pittsburgh coal. Only a few quarries are opened on this bed. They are in Redstone, Perry, Lower Tyrone and Bullskin townships, all in the northern part of the county.

Redstone coal. The Redstone coal was named by Rogers (1858) from exposures along Redstone Creek, near Uniontown. This coal lies between the Fishpot and Redstone limestones and is the first persistent coal above the Pittsburgh coal bed. Commonly the coal is thin, but in the southern part of the Uniontown basin the bed is thicker and is a fair coal. It lies 55 to 90 feet above the base of the Pittsburgh seam.

Fishpot limestone. The Fishpot limestone received its name from Fishpot Run in Washington County. It lies between the Lower Sewickley and Redstone coals and is well developed throughout western Fayette County. In West Virginia this stratum is called the Sewickley limestone from its association with the coal of that name. The limestone lies in a single bed in both the Klondike district and the Uniontown-Connellsville basin where it is a hard gray homogeneous rock which occurs in 1- to 3-foot beds. It breaks with conchoidal fracture and resembles closely all the other Monongahela limestones. In the Brownsville area it is present in all the sections showing this part of the group and ranges from 10 to 30 feet in thickness, and averages a little better than 20 feet. It lies 95 feet above the Pittsburgh coal. In the Uniontown basin the limestone is present in all

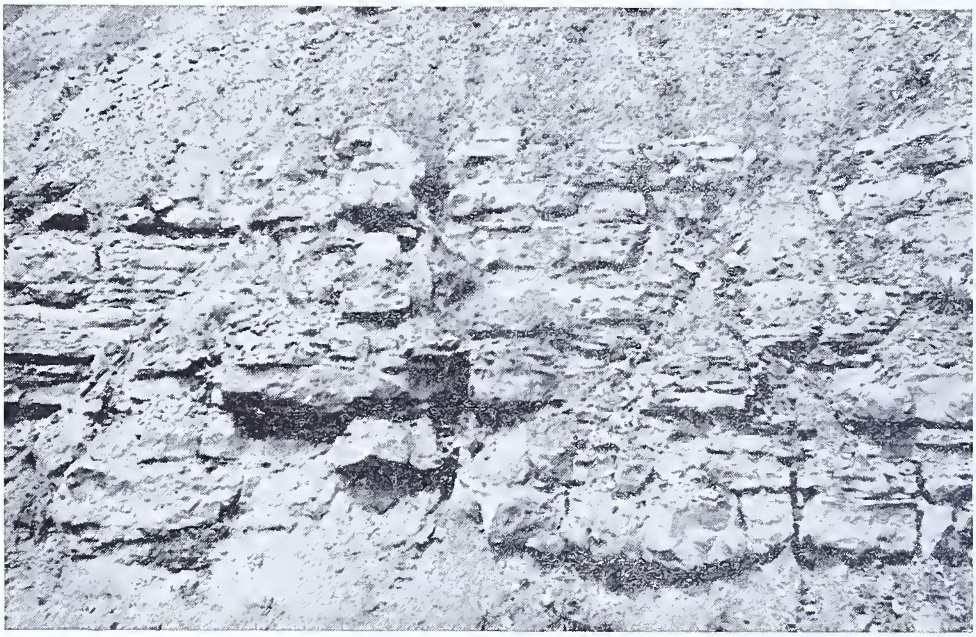

Figure 27. Fishpot limestone in road cut northeast of New Geneva.

the sections and ranges from 6 to 17 feet thick with an average of approximately 12 feet. It lies 110 feet above the Pittsburgh coal.

Lower Sewickley coal. The Sewickley coal bed was named from exposures along Sewickley Creek where it crosses the Uniontown-Connellsville synclinal basin (H. D. Rogers, 1858, pp. 505-618). In Fayette County this coal is split generally into two benches separated by 10 to 30 feet of strata that is chiefly sandstone. Northeast of Uniontown in the Uniontown-Connellsville basin, a third split, of apparently local occurrence, lies between the upper and lower benches. J. J. Stevenson from a study of sections and well records,[16] assumed that the two benches represented the appearance and disappearance of coals at two different horizons. One of these, lying just above the Sewickley sandstone and below the Benwood limestone was termed the Upper Sewickley coal. The second, lying between the Sewickley sandstone and the Fishpot limestone was termed the Lower Sewickley coal. However, in some localities, such as southwest of Uniontown, the intervening strata thin out and the two benches come together to form a single bed that persists in the southwest corner of the county. Roger's description of the type locality and the interval above the Pittsburgh coal indicate that he was referring to the lower bench or the Lower Sewickley coal. This bed in Fayette County lies between the Fishpot limestone and the Sewickley sandstone. It is more persistent in the area than the Upper Sewickley coal and is believed to represent the horizon of the single coal bed in the area southwest of Uniontown where it lies about 140 feet above the Pittsburgh coal. Intervals in the Uniontown-Connellsville basin north of Uniontown and in the Klondike district are respectively about 135 and 120 feet.

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[16] Bull. Geol. Soc. of America, vol. 18, pp. 35-37.

The coal generally has mineable quality and thickness within its area of outcrop south of a line joining Uniontown and Masontown, but to the north it generally is not mineable.

Sewickley sandstone. The Sewickley sandstone takes its name from its association with the Sewickley coals. It lies between the Lower and Upper Sewickley coal beds and is a cross-bedded, medium grained, brownish sandstone containing moderate to large amounts of shale. Near Star Junction it is a good building stone that has been quarried for masonry work around the extensive coke ovens there. In some places the sandstone is lacking from the section or present merely as a sandy shale. It ranges in thickness from 0 to 35 feet and averages 20 feet. Its base lies 120 feet above the Pittsburgh coal in the Brownsville area, 140 feet north of Uniontown in the Uniontown-Connellsville basin, and 150 feet in the neighborhood of Lake Lynn.

Upper Sewickley coal. This coal lies above the Sewickley sandstone and below the Benwood limestone. In general it is as persistent and thick as the Lower Sewickley in most parts of the Klondike district but in the Uniontown-Connellsville basin the Lower Sewickley bed has much greater importance. In the Brownsville area the average thickness of the Upper Sewickley coal is about 18 inches, and it lies approximately 150 feet above the Pittsburgh coal. In the central part of the Uniontown basin it averages 2 feet thick and lies very close to the top of the Sewickley sandstone and about 165 feet above the Pittsburgh coal. In this basin, southwest of Uniontown, its presence was not noted during the field work for this report.

Lower Benwood limestone. The Benwood limestone is the lower part of the Great Limestone of H. D. Rogers (1858). J. J. Stevenson divided the Great Limestone into an upper and a lower part in Report K of the Second Pennsylvania Geological Survey (page 64), but it remained for I. C. White to name the lower division Benwood from Benwood, West Virginia, where the limestone forms cliffs along the Ohio River.[17] In Fayette County the Benwood limestone is divided into several parts by intervening sandstones, shales, and a coal and black shale horizon. The coal is present in only a few sections, but it is probable that the black shale is persistent throughout most of the county and it is used to divide the Benwood into an upper and a lower part.

The Lower Benwood limestone lies between the Benwood coal and black shale and the Upper Sewickley coal. It is composed of light to dark gray, fine-grained limestone in 2- to 10-foot beds interbedded with clay, limy shale and sandstone. Sandstone occurs only in the Brownsville area in a bed 2 to 8 feet thick near the middle of the limestone. Limy shale and clay are common between the massive harder beds of limestone at irregular intervals throughout the entire thickness of the Lower Benwood. In the Brownsville area the limestone averages 50 feet thick and lies 150 feet above the Pittsburgh coal. In the

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[17] Grimsley, G. P., West Virginia Geol. Survey County Reports, Ohio, Brooke and Hancock counties, pp. 90-91, 1906.
Hennen, R. V., West Virginia Geol. Survey County Reports, Marshall, Wetzel and Tyler counties, pp. 294-301, 1909.

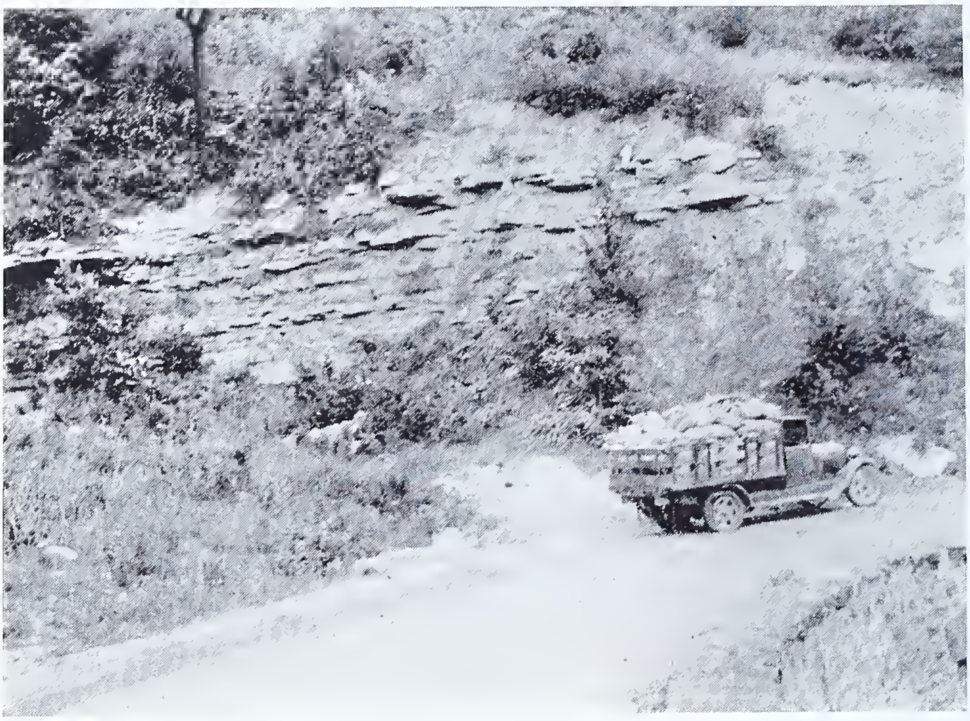

Figure 28. Benwood limestone lower beds.
North bank of Youghiogheny River north of Connellsville.

Uniontown basin it has approximately the same thickness, but its base is 170 feet above the Pittsburgh coal. Many quarries open the Lower Benwood in the northern part of the county both in the Brownsville area and the Uniontown basin.

Benwood coal and black shale. The Benwood coal is so named in this report from its position in the middle of the Benwood limestone. In the area north of Fayette County the coal has been recognized and is reported in the Greensburg folio[18] where it is called the Bench coal. That name is not used here as it is based on the appearance of the outcrop and is not a geographic name. The coal is commonly replaced by black shale in most of the measured sections but can be seen in the Filbert hoisting shaft section and was observed in the field in several places in the northeastern part of the Klondike area. Apparently the black shale is present throughout the county although it may be cut out locally. In the Greensburg area a sandstone lies immediately above the coal and the same is true in the Uniontown basin in Fayette but does not hold in the Brownsville area where the Upper Benwood limestone overlies the coal. The coal where it is present, is 1 to 2½ feet thick, and the black shale may be somewhat thicker. They lie 225 feet above the Pittsburgh seam in the Uniontown basin and 200 feet above in the Brownsville area.

Upper Benwood limestone. The Upper Benwood limestone lies between the Benwood coal and black shale and the Arnoldsburg sandstone. It is similar to the Lower Benwood limestone in character and composition and includes several feet of sandstone near the middle. In the Klondike district it averages 50 feet thick and its base lies 205 feet above the Pittsburgh coal, whereas in the Uniontown basin it averages 40 feet thick and lies 230 feet above the same coal. This limestone is quarried extensively, especially in the southern part of the Uniontown-Connellsville basin in the neighborhood of Chadville.

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[18] Johnson, M. E., Pennsylvania Geol. Surv. Atlas, Greensburg quadrangle, no. 37, pp. 31, 81, 1925.

Arnoldsburg sandstone. The Arnoldsburg sandstone was named for Arnoldsburg, West Virginia, where it has been extensively quarried for building stone.[19] In Fayette County, although much thinner than in West Virginia, the sandstone is fairly persistent and is recorded in many of the measured sections. It is a medium-grained, soft, gray-brown sandstone, occurring in thin to medium beds. It does not form cliffs in Fayette County as it does in West Virginia, but can be seen in many road cuts and a few quarries. It ranges from 4 to 21 feet in thickness and averages about 10 feet. It lies 270 feet above the Pittsburgh coal in the Uniontown basin and 255 feet above in the Klondike district.

The Lower Uniontown coal and Fulton green shale which underlie the Arnoldsburg sandstone in Monongalia and Marion counties, West Virginia[20] are commonly absent in Fayette County, but in a few sections a gray shale may represent the Fulton and a black carbonaceous shale the Lower Uniontown coal.

Uniontown limestone. The Uniontown limestone is the uppermost part of the Great Limestone of H. D. Rogers (1858). J. J. Stevenson (1877, pp. 37, 38) divided the Great Limestone into an upper and a lower part and named the upper "Uniontown," from its position immediately below the coal of that name. The limestone lies between the Arnoldsburg sandstone and the Uniontown coal. It ranges from 5 to 30 feet thick including some interbedded limy shales, and averages about 10 feet. In the Uniontown basin it is 275 feet and in the Klondike district 265 feet above the Pittsburgh coal. It is a relatively unimportant limestone and has been opened only in a few quarries located in Dunbar, North Union and Menallen townships.

Uniontown coal. The term Uniontown was first applied by H. D. Rogers (1858, pp. 624, 625) and later by J. J. Stevenson (1877, p. 36) to a coal that crops out at numerous points in the city of Uniontown along Coal Lick Run and Redstone Creek. In naming and correlating the coal both Rogers and Stevenson greatly underestimated the structural depth of the Uniontown-Connellsville basin at Uniontown because they give intervals between this coal and the base of the Pittsburgh coal as about 200 and 260 feet, respectively. Since the investigations of these men, the Pittsburgh coal has been developed extensively all through this basin and accurately surveyed elevations on its floor are available. The mine shaft sections and the accompanying structure map, which was compiled where possible from surveyed mine

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[19] Hennen, Ray V., West Virginia Geol. Surv. County Reports, Wirt, Roane and Calhoun counties, pp. 202-204, 1911.

[20] Hennen, Ray V., and D. B. Reger, West Virginia Geol. Surv. County Reports, Marion, Monongalia and Taylor counties, pp. 253, 254, 1913.

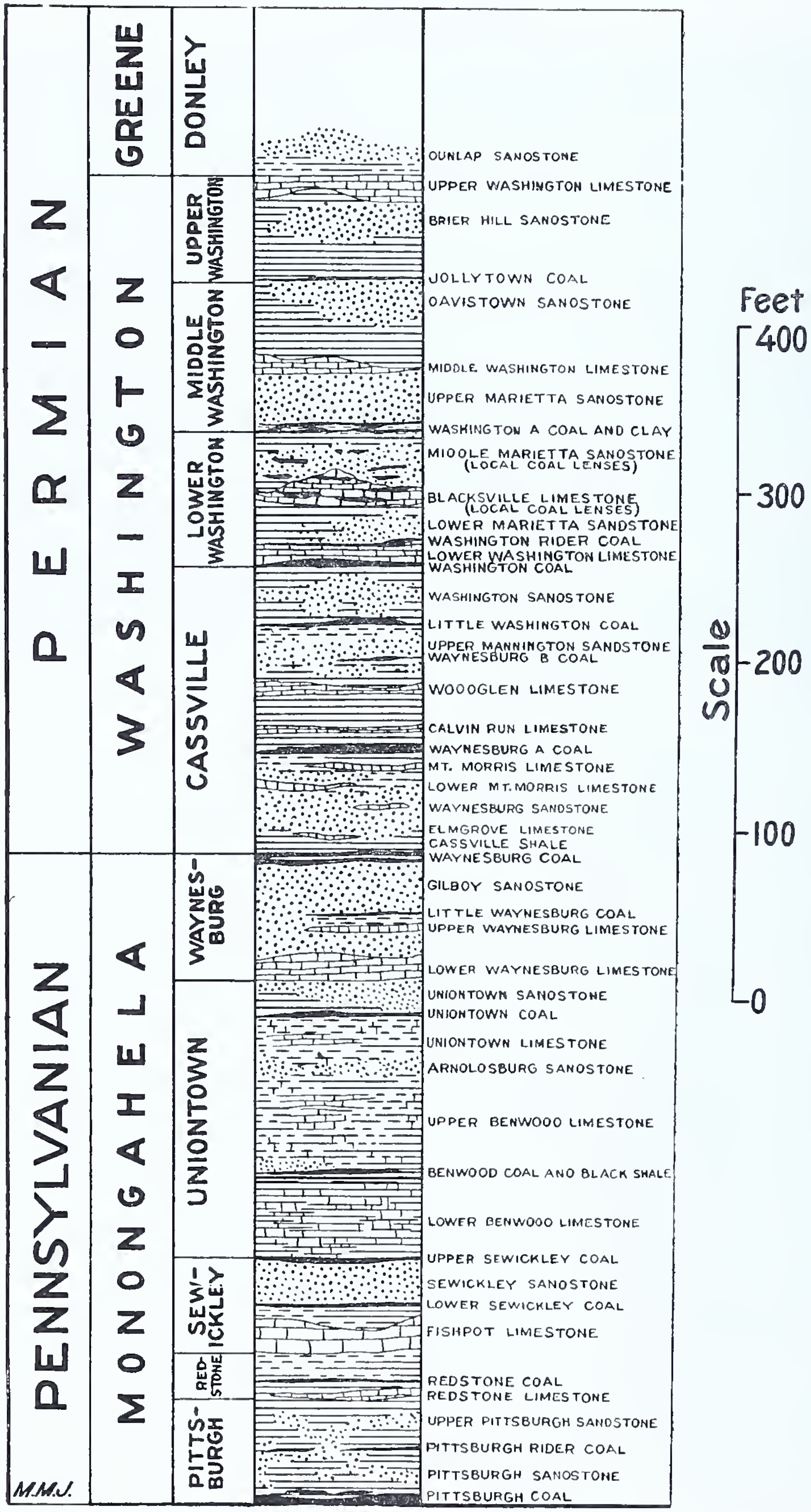

Figure 29. Columnar section of Monongahela and Washington groups.

elevations, show that the interval between the coal in question and the base of the formation ranges between 335 and 370 feet and averages 350 feet. This interval, the physical characteristics of the bed, and stratigraphic sequences all indicate that the coal correlates with the Waynesburg coal of Greene County and that Rogers and Stevenson were misled in applying the name Uniontown to the coal by their short structural depth for the syncline. A detailed explanation of the correlation is given in the section of this report titled "Correlation of the Waynesburg coal bed." Despite the fact that the type Uniontown coal was a miscorrelation the name has become entrenched in the literature because there is a coal bed with associated black shale that occurs more or less regularly between the Uniontown limestone and sandstone at an interval of 250 to 310 feet above the base of the formation. This horizon has a widespread occurrence in western Pennsylvania and has been termed the Uniontown coal in all geological reports. It occurs generally as a thin, irregular bed throughout Fayette County. In the Klondike district the coal has an average thickness of about 2 feet and lies at an average interval of 295 feet above the base of the formation. In the Uniontown-Connellsville basin it averages one foot thick and lies 280 feet above the base of the Pittsburgh coal. The Leith shaft section contains a coal bed at 250 feet above the base of the formation that probably correlates with the Uniontown coal.

Uniontown sandstone. The Uniontown sandstone was named from its proximity to the Uniontown coal by I. C. White (1891, p. 58). It is a weak, thin-bedded limonite-stained sandstone which in a few places becomes thick-bedded. When fresh it is gray, medium-grained and contains a considerable amount of shaly material as well as numerous muscovite flakes. Cross-bedding is present but not common. The thickness ranges from 0 to 20 feet, but the sandstone is not prominent and is seldom seen in outcrop except in road cuts and a few scattered quarries. In the Uniontown-Connellsville basin it averages 5 feet thick and lies 290 feet above the Pittsburgh coal. In the Klondike district it has an average thickness of 10 feet and lies 310 feet above the Pittsburgh.

Waynesburg limestone. The Waynesburg limestone was named by J. J. Stevenson (1877, p. 35) from its position below the Waynesburg coal. It lies between the Uniontown sandstone and the Little Waynesburg coal. In character it is similar to the other Monongahela limestones, being dense, homogeneous, gray, buff or dark gray in color and breaking with conchoidal fracture. It occurs in 1- and 2-foot massive beds and may be interstratified with limy shale. In the Klondike district it occurs in two benches separated by 10 feet of soft sandstone in part limy. The lower bench ranges from 10 to 25 feet in thickness and averages 15 feet. The upper bench ranges from 0 to 13 feet and averages 5 or 6 feet. They lie 315 and 345 feet respectively above the Pittsburgh coal, and 40 to 80 feet below the Waynesburg coal. In the Uniontown-Connellsville basin the limestone is not divisible into three parts because of poor exposures. It has an average thickness of 20 feet with a variation from 10 to 25 feet. It lies 300

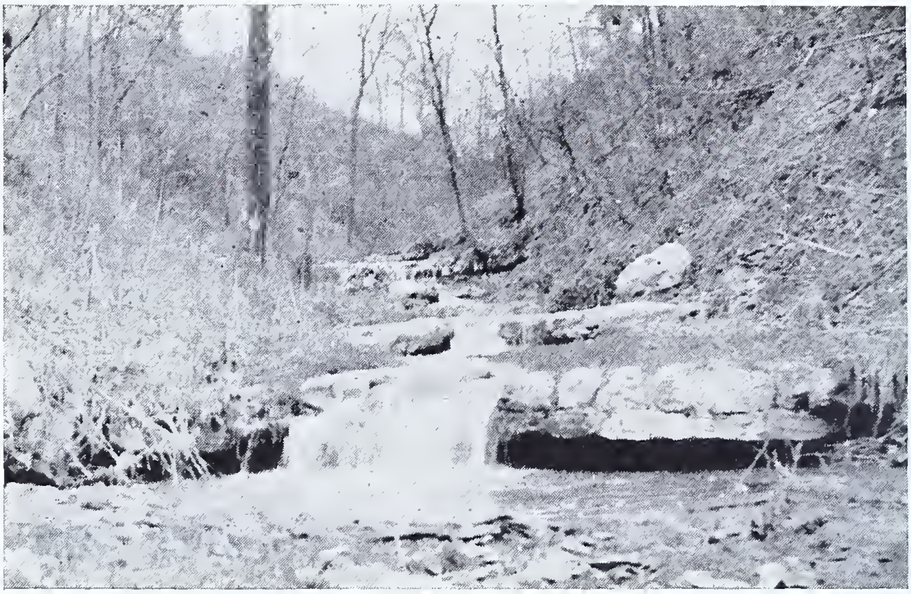

Figure 30. Waynesburg limestone on North Fork of Middle Run, 2 miles east of Adah.

feet above the Pittsburgh coal and about 50 feet below the Waynesburg coal. This limestone is not quarried in Fayette County, but one prospect pit was seen southeast of Brownsville.

Little Waynesburg coal. This coal, named by J. J. Stevenson (1877, p. 34), occurs as a thin bed lying just below the Gilboy sandstone. In Fayette County it is fairly persistent as a thin coal, less than a foot thick but in much of the surrounding territory the horizon is merely marked by black shale. In the Klondike district the coal averages less than one foot thick and lies 335 feet above the Pittsburgh bed, whereas in the Uniontown-Connellsville basin it is less persistent and lies 300 feet above the Pittsburgh.

Gilboy sandstone. The Gilboy sandstone was named by I. C. White[21] from its exposure in the Gilboy cut on the Baltimore & Ohio Railroad east of Mannington, West Virginia. It lies between the Waynesburg and Little Waynesburg coals. The sandstone is medium-bedded, brownish, micaceous and not particularly hard in most of its outcrops, but in a few places becomes more massive and is suitable for quarrying for road base and rough building stone. It ranges in thickness from 0 to 20 feet and averages 10 feet in the Klondike district where it is 370 feet above the Pittsburgh bed and less than 10 feet in the Uniontown basin where it lies 335 feet above the Pittsburgh.

Waynesburg coal and clay. The Waynesburg coal was named by H. D. Rogers (1858, vol. II, pp. 505, 506) from Waynesburg, Greene County, just east of which city it has long been mined for local uses. This coal is the uppermost member of the Monongahela group. It lies between the Gilboy sandstone and the Cassville shale where the latter has not been cut out by the unconformity below the Waynesburg sandstone. The coal is always multiple bedded, commonly being separated into two or three benches by gray clay shale or plastic clay partings. In the Klondike district it is usually a triple-benched bed with the lower two benches representing the portion that is mined on a commercial scale. Through this area it has an average thickness of 5½ feet and the top of the bed, which is the upper limit of the Monongahela formation, lies at an average interval of 390 feet above the base of the formation. In the Uniontown-Connellsville basin the coal here identified as Waynesburg is a double-benched bed with an average thickness of 3 feet and the top of the beds averages 350 feet above the base of the formation. For a long time this coal was known in the vicinity of Uniontown as the Uniontown coal because of the early works of Rogers (1858) and Stevenson (1877). It was first correlated with the Waynesburg coal by Campbell (1902), who unfortunately did not present the reasons for the correlation.

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[21] White, I. C., Report on coal: West Virginia Geol. Surv., vol. II, p. 15, 1903.

CORRELATION OF THE WAYNESBURG COAL BED IN THE UNIONTOWN-CONNELLSVILLE BASIN*

The coal bed in the Uniontown-Connellsville basin that is correlated with the Waynesburg coal bed of the Klondike district and Greene County has roughly a flattened-oval-shaped outcrop extending from the Youghioheny River southwest to Chadville, 3 miles southwest of Uniontown. Good exposures or openings on the coal were found during field work for this report at about one mile southeast of Leisenring; near West Leisenring, Bethelboro and Hogsett; and in Uniontown along the banks of Coal Lick Run and Redstone Creek. In these exposures the coal bed consists of two benches separated by a shale or clay shale parting of variable thickness. It is underlain by a gray plastic clay and overlain generally by black to drab or gray shale which is in turn overlain by a medium-to-heavy-bedded, medium-to-coarse-grained, drab sandstone up to 45 feet thick. Locally, the sandstone rests directly on the coal. These similar characteristics of the observations plus a regular interval of 335 to 370 feet to the base of the Pittsburgh coal, as determined from the structure map (based chiefly on surveyed mine elevations) were considered sufficient proof that the observations were made on one coal horizon or bed which has a persistent occurrence in the basin.

Footnote: The top of the Monongahela group in the Uniontown-Connellsville basin has been in dispute for many years. As pointed out in the text, the bed here considered to be the equivalent of the Waynesburg was called the Uniontown by Rogers, who estimated it to lie 200 feet above the Pittsburgh coal. He correlated as Waynesburg, a split coal that lies about 100 feet higher, the base of the lower split lying 435 feet above the Pittsburgh coal and the top of the split as much as 455 feet above. Later J. J. Stevenson followed the same correlation but estimated the interval of the "Uniontown" coal at 260 feet above the Pittsburgh coal. The interval is now known to average 340 to 350 feet. Still later M. R. Campbell correlated the "Uniontown" coal at Uniontown as the Waynesburg, as is done here. Several geologists contributed to this study without coming to a unanimous opinion.

The case for the older opinion has been summed up by Hickok as follows:

"This correlation is based on several lines of evidence. First, the general sequence of beds in the Monongahela of the Uniontown basin is more complete and corresponds with the sequence in the Brownsville area where the upper pair of coals is taken to be the Waynesburg. Second, the strata up to and including the Lower Benwood limestone show thickening from the Brownsville area to the Uniontown basin. If the upper pair of coals is taken as the Waynesburg coal, this thickening eastward affects the strata on up to the Waynesburg coal in about the same degree as it affects those below, whereas, if the lower coal is taken as the Waynesburg a very decided thinning of the strata to the east must have affected the strata between the Benwood limestone and

A brief history of the correlations made on this bed in the past by several geologists is the simplest manner of presenting the problem. Rogers, 1858 (pp. 506, 624, 625), the first investigator, applied the name Uniontown to a coal bed that was exposed in the city of Uniontown, notably in the banks of Coal Lick Creek and Redstone Creek, near the points where the National Pike crosses these streams. He states that the coal was about 3 feet thick, consisted of two benches, occurred between two beds of limestone, and that the interval to the base of the Monongahela formation was about 200 feet. Unfortunately, the exact locations of these exposures could not be determined during the field work for this report. However, only one coal bed is known to occur along Coal Lick Creek and Redstone Creek near the National Pike crossings in Uniontown and as sections of this coal very closely fit the sections given by Rogers, it seems reasonable to assume that the observations were made on the same bed. If this be true, the interval to the base of the Pittsburgh coal is about 350 feet and not 200 feet as listed by Rogers. Also, a coal bed only 200 feet above the Pittsburgh bed would not outcrop at any place in Uniontown along the mentioned streams.

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the Waynesburg coal which does not correspond to the prevailing trend and seems to be unlikely. Third, paleobotanical evidence favors the coals at 430 to 450 feet being the Waynesburg. The Cassville shale lying directly above the Waynesburg coal contains an abundant and distinctive flora which has been studied in West Virginia and in Greeno County, Pennsylvania.[15]

"Examination of the shales lying above the coals at 345. 405, 430 and 450 feet above the Pittsburgh coal showed few, if any, plant remains above the 345 and 405 coals, but moderately plentiful to abundant remains above 430 and 450 coals. Since weathering of the shales rapidly destroys the delicate ferns, specific characteristics were not determinable at most exposures of these shales, but at one locality north of Uniontown four species were recognized, all of which are confined to the Waynesburg horizon according to the literature."

As the matter involved the question of which horizon should be used to represent the top of the Monongahela group on the geologic map of the county, the writer gave the matter some study. In the end he was led to agree with Campbell's interpretation, but leaving the door open for further study, especially of the fossils.

In general the rock formation of Pennsylvania thickens from northwest to southeast, which would in itself favor the idea of increased thickness of the Monongahela group in the Uniontown basin. Thus the immediately underlying Conemaugh group thickens from 600 feet around Pittsburgh to 900 feet in Somerset County and the Georges Creek basin of Maryland. But as identified in the Georges Creek basin, the Monongahela group has a thickness of only 240 feet. As compared with 365 to 395 feet in the Klondike area, this indicated a decided thinning eastward. A study of the sections as presented in figure 31, and dividing the Klondike area into east and west gave the following results:

Average interval to Pittsburgh coal

Coals	West Klondike	East Klondike	Uniontown
Waynesburg A		440	445
Waynesburg	384	372	340
Uniontown	277	289	251
Upper Sewickley		199	166
Lower Sewickley	146	139	130
Redstone	70	72	86
Pittsburgh	0	0	0

According to the sections on figure 31, the interval to the Redstone coal is silghtly increased. All of the others are decreased. The sections in the east and west Klondike indicate a slight decrease from west to east, rather than an increase as might be expected if the thickness of the formations as a whole were increasing eastward. For the purpose of this report, it was decided, pending more conclusive fossil or other evidence, to draw the top of the Monongahela group at the Waynesburg-Uniontown coal in the Uniontown basin in accord with the earlier conclusions of Campbell.

G. H. A.

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[15] Fontaine, Wm. M., and I. C. White, Permian or Upper Carboniferous Flora: Pennsylvania 2d Geol. Sur., rept. pp. 1880.

White, David, Fossil flora of West Virginia: West Virginia Geol. Surv., vol. V(A), part II, pp. 390-453, 1913.

J. J. Stevenson, 1877 (pp. 152, 153, 162) also lists numerous exposures of a double-benched coal bed that crops out in Uniontown and is undoubtedly the same as Rogers' Uniontown coal. He gives it an interval of about 260 feet to the base of the formation and states that it is not always overlain by a thin limestone bed. In fact, he lists more sections without than with an overlying limestone. Several of Stevenson's locations on this coal were found and observed during the present field work. These locations, none of which showed an overlying limestone, had an average interval of 350 feet to the base of the formation as obtained from the accompanying structure map. Thus, with the great amount of accurate information on structure that was available for this report, it is evident that both Rogers and Stevenson greatly underestimated the structural depth of the basin at Uniontown.

The Waynesburg coal of Rogers and Stevenson in the Uniontown-Connellsville basin consisted of the upper two beds of a series of three thin coal beds that outcrop in the higher hilltops in the vicinity of Uniontown. The lower bed of this series of three coals lies about 400 feet above the Pittsburgh coal according to present information on structure and was correlated with the Little Waynesburg coal. The upper two beds were considered as two benches of a single horizon and were correlated with the Waynesburg coal of the Klondike district. They are separated by 10 to 25 feet of shale and sandy shale and, according to present information on this structure, the base of the lower split is about 435 feet above the bottom of the Pittsburgh coal and the top of the upper split has an average interval of 455 feet to the same coal. However, at the time these men made the above correlations, they were under the impression that the interval was not nearly as great as that proven by the subsequent development of the Pittsburgh coal bed. In this report, the three coals described above are not definitely correlated. It is suggested that they may represent either a double-benched Waynesburg A, and the Waynesburg B coals, or the Waynesburg A, and a double-benched Waynesburg B bed.

Campbell (1902, 1903) was the first investigator to correlate the bed lying 350 feet above the Pittsburgh coal at Uniontown with the Waynesburg coal of western Fayette and Greene counties. However, he did not present reasons for this correlation, which apparently was based only on intervals to the Pittsburgh coal.

A study was made of drill-hole records and measured sections available in the geological folios of Fayette and Greene counties and in this and other reports on the geology of southwestern Pennsylvania. These sections were projected onto two parallel lines that were approximately at right angles to the rock structure of the region. The first of the lines passes through Waynesburg and Greensboro, Greene County, and the second which was offset 9½ miles to the northeast, passes through Fredericktown, Washington County, on the Monongahela River and Uniontown, Fayette County. All sections, Nos. 1 to 13 in the accompanying figure, up to 6 miles east of Waynesburg are projected onto the first line and the remaining sections are all projected to the second line. Sections numbered 38, 39 and 40 are not projected to any definite line but represent the best available correlations on the Monongahela formation in the coal basins lying

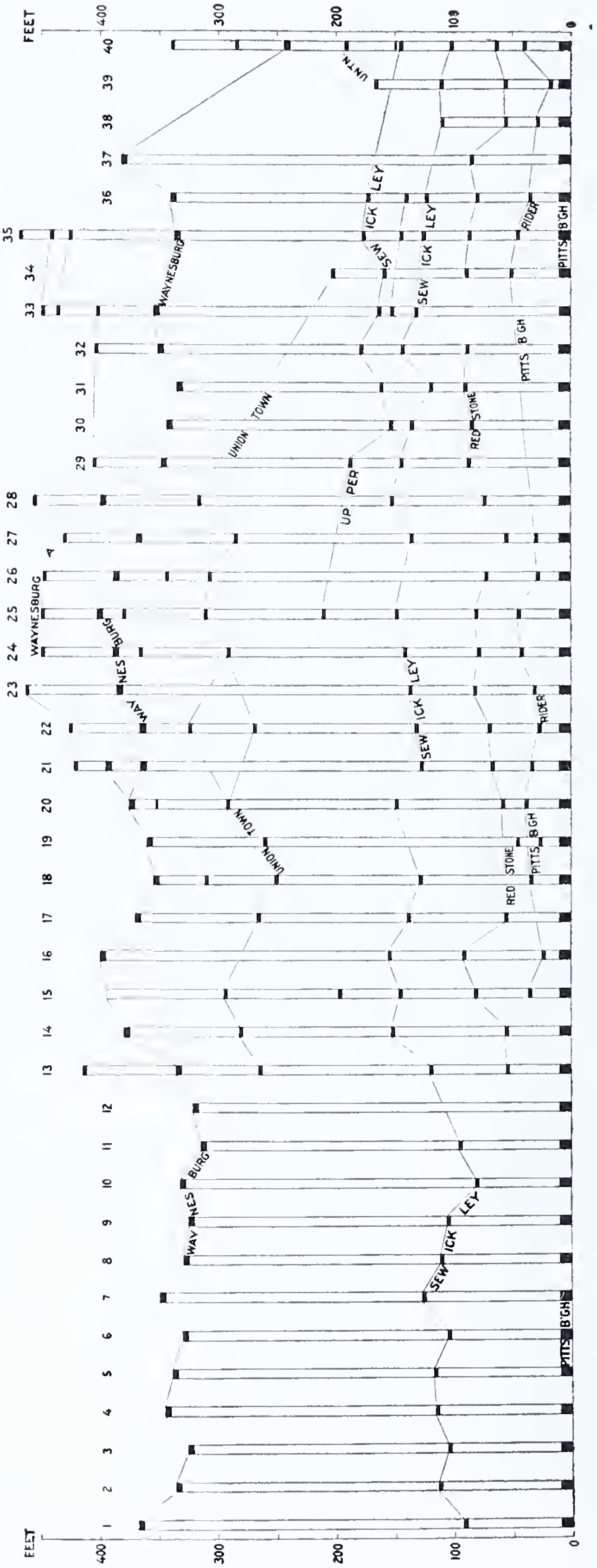

Figure 31. Skeletal sections between Waynesburg and Uniontown.

(Distances refer to position of the section when projected onto the lines that are normal to the structure.)

1. Drill hole (No. 37) ¾ mile west of Waynesburg.
2. Drill hole (E) ½ mile west of Waynesburg.
3. Drill hole (No. 24) in Waynesburg.
4. Drill hole (No. 27) ¾ mile east of Waynesburg.
5. Drill hole (No. 28) 1¼ miles east of Waynesburg.
6. Drill hole (No. 31) 1½ miles east of Waynesburg.
7. Drill hole (G) 1¾ miles east of Waynesburg.
8. Drill hole (No. 33) 2¼ miles east of Waynesburg.
9. Drill hole (No. 24) 2½ miles east of Waynesburg. The point of projection of this hole onto the cross-structure line coincides with the point at which the Bellevernon anticlinal axis crosses the line.
10. Drill hole (No. 40) 2¼ miles east of Waynesburg.
11. Drill hole (No. 41) 3¼ miles east of Waynesburg.
12. Drill hole (No. 43) 5¼ miles east of Waynesburg.
13. Generalized section of Waynesburg quadrangle.

Sections 2, 7 and 13 are from the Waynesburg folio, U. S. Geological Survey Geologic Atlas of the United States. All the others are from Geology and Mineral Resources of Greene County: Pa. Topog. and Geol. Survey Bull. C 30, 1932.

The following sections are projected onto the second cross-structure line and distances are measured from the point at which the Bellevernon anticlinal axis crosses this line.

14. Measured section at Rice Landing, Greene County, 1½ miles east of the Bellevernon axis: Stratigraphy of Bituminous Coal Fields of Pennsylvania, Ohio and West Virginia; U. S. Geol. Survey, Bull. 65, 1891.
15. Sarah air shaft, 3½ miles east of the Bellevernon axis.
16. Sarah hoisting shaft, 3¾ miles east of the Bellevernon axis.
17. Measured section at West Brownsville, Washington County, 4½ miles east of the Bellevernon axis. U. S. Geol. Survey, Bull. 65, 1891.
18. Measured section at Brownsville, 6½ miles east of the Bellevernon axis, Report KK, Penna. 2d Geol. Survey, 1877.
19. Average section of Cassville district, West Va., Coal in Monongalia County, West Va., W. Va. Geol. Survey, 1932. The coals of this section are not correlated as the district lies 23 miles south of the cross-structure line.
20. Republic shaft, 7¾ miles east of the Bellevernon axis.
21. Ralph hoisting shaft, 8¼ miles east of the Bellevernon axis.
22. Ralph air shaft, 8¼ miles east of the Bellevernon axis.
23. Orient shaft, 8½ miles east of the Bellevernon axis.
24. Filbert air shaft, 9 miles east of the Bellevernon axis.
25. Filbert hoisting shaft, 9¼ miles east of the Bellevernon axis.
26. Lambert shaft, 9¼ miles east of the Bellevernon axis.
27. Brier Hill shaft, 9½ miles east of the Bellevernon axis.
28. Edenborn shaft, 9½ miles east of the Bellevernon axis.
29. Buffington shaft, 10¼ miles east of the Bellevernon axis.
30. Oliver No. 2 shaft, 16¼ miles east of the Bellevernon axis.
31. Leisenring No. 2 shaft, 16½ miles east of the Bellevernon axis.
32. Oliver No. 1 shaft, 16¾ miles east of the Bellevernon axis.
33. Lemont No. 1 air shaft, 17½ miles east of the Bellevernon axis.
34. Leith shaft, 17½ miles east of the Bellevernon axis.
35. Leisenring No. 3 shaft, 17¾ miles east of the Bellevernon axis.
36. Leisenring No. 1 shaft, 18 miles east of the Bellevernon axis.
37. Hill farm drill hole, 19¼ miles east of the Bellevernon axis.

The following sections are not projected onto the cross-structure lines but represent an approximate continuation of the lines eastward.

38. Generalized section in the Ligonier Valley, Westmoreland County. (If projected it would be about 10 miles east of Uniontown.) Report KKK, Pa. 2d Geol. Survey.

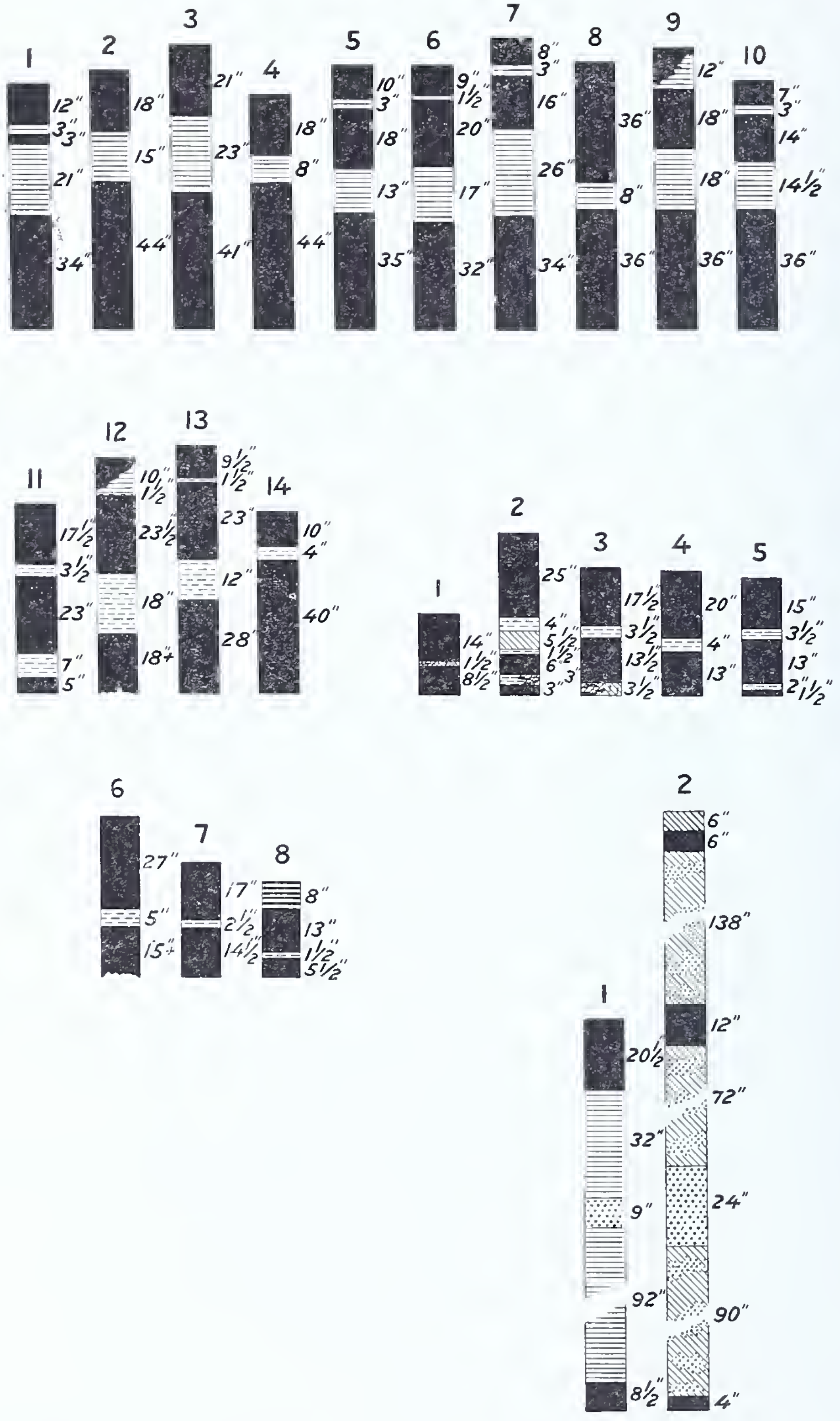

Figure 32. Sections of coal between Waynesburg and Uniontown.

39. Generalized section in the Salisbury basin, Somerset County, about 36 miles east of Uniontown. Report HHH, Pa. 2d Geol. Survey.
40. Generalized section of Georges Creek basin, Maryland, about 46 miles east of Uniontown: Second Report on Coals of Maryland, Vol. II, Md. Geol. Surv., 1922.

to the east of Fayette County. The sections are skeletal and show only the important coal beds. Correlations are the ones used in the reports from which the particular section was taken.

From the figure, it is readily ascertained that the Monongahela formation thickens slightly from Waynesburg eastward across the structure to the Klondike district of western Fayette County. Eastward from here, the formation becomes thinner in the Uniontown-Connellsville basin and apparently continues to decrease in thickness to the Georges Creek basin at Frostburg, Md. If the coals be correlated only by intervals from Waynesburg into the Uniontown-Connellsville basin, the coal bed lying 350 feet above the Pittsburgh coal at Uniontown can be correlated only with the Waynesburg coal horizon. It has the proper interval and the other coal beds lying between it and the Pittsburgh coal at Uniontown have equivalent coal horizons in the regions to the west in western Fayette and Greene counties.

A comparison of measured sections of the Waynesburg coal bed in the Waynesburg quadrangle, Greene County, and the Klondike district of Fayette County, was made with measured sections of the coal beds in the Uniontown-Connellsville basin of which the tops have average intervals of 350 and 455 feet above the base of the Pittsburgh coal. These comparisons show that a great similarity exists between the sections of the Waynesburg coal and the 350-foot coal. There, apparently, is no similarity in the sections of the Waynesburg coal and the series of three coals with the top member at 455 feet above the Pittsburgh bed. Hence, the measured coal sections indicate that the 350-foot coal in the Uniontown-Connellsville basin is properly correlated with the Waynesburg coal of Greene County and the Klondike district. The similarities are readily discernible in Figure 32.

Waynesburg coal in the Waynesburg quadrangle, Greene County.

1. Custom bank 2 miles east of Waynesburg.
2. Custom bank 2 miles east of Waynesburg.
3. Custom bank 3 miles east of Waynesburg.
4. Custom bank 4 miles east of Waynesburg.
5. Custom bank 6 miles northeast of Waynesburg.
6. Custom bank 7 miles northeast of Waynesburg.
7. Custom bank 8 miles northeast of Waynesburg.
8. Custom bank 9 miles northeast of Waynesburg.
9. Custom bank 10 miles northeast of Waynesburg, at the Monongahela.
10. Average section for Waynesburg quadrangle.

Waynesburg coal in the Klondike district, Fayette County.

11. Custom bank 1 mile east of Monongahela River.
12. Custom bank 3 miles east of Monongahela River.
13. Custom bank 6 miles east of Monongahela River.
14. Custom bank 11 miles east of Monongahela River.

Sections of coal bed with 350-foot interval to the Pittsburgh in the Uniontown-Connellsville basin.

1. Custom bank near West Leisenring.
2. Custom bank 1 mile southeast of Leisenring.
3. Outcrop on Coal Lick Run in Uniontown.
4. Custom bank on Cove Creek near Hogsett.

5. Outcrop near Evans.
6. Outcrop ½ mile east of Bethelboro.
7. Outcrop 1 mile west of Pechim.
8. Outcrop 1 mile west of New Haven.

Section of series of coal beds with the top-member 455 feet above the Pittsburgh coal in the Uniontown-Connellsville basin.

1. Lemont No. 1 air shaft, 1 mile west of Bethelboro.
2. Leisenring No. 3 shaft at Monarch.

The detailed information on the intervals and measured coal sections presented in the preceding discussion points strongly towards the correlation of the coal with the 350-foot interval as the Waynesburg coal bed. These indications together with the persistent occurrence of overlying sediments that resemble the Cassville shale and Waynesburg sandstones should be deciding factors in calling it the Waynesburg coal. The sporadic limestone horizon lying shortly above the coal would then correlate properly with the Elm Grove limestone. During field work for the present report, fragmentary specimens of fossil plant life were collected from the shales immediately overlying the coal in this basin. Unfortunately none of the specimens could be identified definitely by the paleobotanists of the National Museum, Washington, D. C.

The correlation of this coal bed with a 350-foot interval to the Pittsburgh coal, leaves the Uniontown coal without a type locality as it was Rogers' original Uniontown coal. It is suggested that the coal bed occurring 250 feet above the base of the formation in the Leith shaft section be substituted for the type locality of the Uniontown coal. This bed, or its equivalent horizon, crops out around Uniontown and throughout Fayette County. It has an interval of 250 to 310 feet above the base of the formation and seems fairly persistent.

PERMIAN SYSTEM

WASHINGTON GROUP

General account. The Washington group was named from the fine exposures and extensive outcrops of these strata in Washington County, Pennsylvania. It lies between the Monongahela and Greene groups, and together with the latter forms the Dunkard series which was formerly called the Upper Barren Coal Measures. The group consists of shale, sandstone and limestone, with several impure or thin beds of coal which are not of economic importance in Fayette County. The base is taken at the top of the Waynesburg coal and the top at the top of of the Upper Washington limestone. A general account of the whole will be given, followed by accounts of the individual named beds.

Generalized section of the Washington group

Name and character of strata	Thickness (feet)		Above Waynesburg coal
	Variation	Klondike district	Klondike district
Upper Washington limestone (top)	5–20	15	400
Brier Hill sandstone	10–30	15	370
Jollytown coal	0–1	1	340
Davistown sandstone	10–30	20	320
Middle Washington limestone	2–10	7	285
Upper Marietta sandstone	0–25	20	260
Washington A coal and clay	0–10	5	250
Middle Marietta sandstone and local coals	5–30	15	225
Blacksville limestone and local coals..	5–20	10	210
Lower Marietta sandstone	0–15	10	200
Washington Rider coal	0–1	½	195
Lower Washington limestone	2–17	10	185
Washington coal	1–4	3½	170
Washington sandstone	0–35	10	150
Bristol limestone	0–4	lacking	145
Little Washington coal	0–4	3	135
Upper Mannington sandstone	5–20	10	120
Waynesburg B coal	½–2	1	115
Lower Mannington sandstone	0–6	4	105
Woodglen limestone	0–9	7	95
Colvin Run limestone	0–12	5	75
Waynesburg A coal	1–5	3	60
Mt. Morris limestone	0–10	3	50
Mt. Morris sandstone	0–7	4	45
Lower Mt. Morris limestone	0–10	4	40
Waynesburg sandstone (with limestone lenses)	10–45	25	16
Elm Grove limestone	0–5	2	13
Cassville (plant) shale	0–25	13	0

Most of the Washington group is present in both districts but correlation of the middle and upper members of the group is possible only in the Klondike district. Here mine shaft sections show detailed information up to the Washington A coal and may be extended to the top of the group by reasonably good exposures in the vicinities of the mine shafts. In the Uniontown-Connellsville basin the shaft sections extend only into the lower part of the group and the exposures of the higher members are very unsatisfactory, as they show only incomplete and short stratigraphic intervals that cannot be tied together for a composite section. Because of the meager data available in this basin, the strata of Dunkard age cannot be correlated across the intervening Fayette anticline with the strata of similar age in the Klondike district. In the Uniontown-Connellsville basin, the Dunkard strata above the Waynesburg coal appear to consist chiefly of series of dark to drab shale and sandy shale with thin, discontinuous lenses or beds of sandstone and fresh-water limestone. Thin coal beds of sporadic occurrence are numerous and doubtful correlations of those appearing most persistently are made. The greatest thickness of strata of Dunkard age remaining uneroded in the Uniontown-Connellsville basin is near Monarch in Dunbar Township, where approximately 325 feet remain in the highest hills.

One generalized section for this group in the Klondike district is given to show its average composition. Correlations of the Permian strata in the Uniontown-Connellsville basin with the named members of similar age in the Klondike district and Greene County are not attempted for lack of sufficient information concerning their character. In this basin the strata appear to be very different in composition and sequence from those in the basins to the west. Consequently, any attempted correlations without further study would be only guesses and would bewilder the reader as well as add to an already confused literature. The only members that appear to be fairly persistent in the Uniontown-Connellsville basin are the Waynesburg sandstone, occurring shortly above the Waynesburg coal, and thin coal beds occurring at average intervals of 50, 85, 105, 130 and 200 feet above the Waynesburg coal.

Areal distribution. The Washington group is present only in the western part of Fayette County. It lies in two areas, one in the center of the Uniontown-Connellsville district, the other in the Klondike district. In the Uniontown-Connellsville district the main body of Washington sediments extends along the Uniontown synclinal axis from the Youghiogheny River to the vicinity of Chadville.

In the Klondike district Washington sediments occupy a large area of surface along the Lambert synclinal axis. Beginning on the hills north of Masontown, these strata extend northward across Dunlap Creek to Redstone Creek, which has cut through them into the underlying Monongahela group. West of this large area Lower Washington rocks cap all the high hills and interstream areas. North of Redstone Creek, along both the Lambert syncline and the Brownsville anticline, Lower Washington sediments cap all the hills and in a few places along the synclinal axis they extend down into the valleys.

Measured sections of the Washington group. Nowhere in the county can a complete section of the Washington group be measured, but the deeper shafts to the Pittsburgh coal afford measurements of the lower part of the group, and surface exposures along the National Pike and a few secondary roads give incomplete and partial sections of all parts of the group. The upper part, however, is not well known, as it is preserved only in the upper parts of hills where weathering is deep. The following shaft sections are published by courtesy of the H. C. Frick Coal and Coke Company:

Washington section in the Edenborn shaft

Thickness		Strata	Name	Above top of Waynesburg coal	
Ft.	in.			Ft.	in.
4	0	Surface clay			
12	7	Shale			
0	10	Limestone	(Colvin Run)	62	5
8	1	Plastic clay			
4	0	Coal	(Waynesburg A)	57	4
8	6	Limestone	(Upper Mt. Morris)	48	10
18	6	Plastic clay			
2	0	Limestone	(Lower Mt. Morris)	28	4
8	0	Plastic clay			
20	4	Shale	(Cassville)	0	0
		Coal	(Waynesburg)		

Washington section in Lambert shaft

Thickness Ft.	Thickness in.	Strata	Name	Above top of Waynesburg coal Ft.	Above top of Waynesburg coal in.
8	4	Surface			
1	6	Shale			
2	1	Coal and clay	(Blacksville limestone) horizon	219	6
2	0	Limestone			
2	0	Coal			
1	3	Shale			
4	1	Plastic clay			
1	6	Coal			
0	7	Limestone			
27	1	Blue clay shale			
0	5	Coal	(Washington Rider)	192	0
2	3	Plastic clay			
0	8	Limestone	(Lower Washington)	189	1
6	3	Plastic clay			
0	8	Coal	(Washington)	179	8
0	6	Slate			
0	6	Coal			
0	6	Slate			
1	0	Coal			
16	3	Shale			
11	8	Black shale			
2	5	Coal	(Little Washington)	149	4
2	6	Plastic clay			
14	3	Sandy shale			
10	9	Sandstone	(Upper Mannington)	121	10
4	4	Shale			
0	9	Coal	(Waynesburg B)	115	6
0	5	Slate			
0	10	Coal			
5	6	Sandstone	(Lower Mannington)	110	0
2	6	Black shale			
2	6	Limestone	(Woodglen)	105	0
11	0	Plastic clay			
7	6	Limestone	(Colvin Run)	86	6
22	0	Black shale			
3	6	Coal	(Waynesburg A)	61	0
13	0	Plastic clay			
7	0	Sandstone	(Waynesburg)	16	0
23	0	Plastic clay			
2	0	Sandstone			
16	0	Black shale	(Cassville)	0	0
0	0	Coal	(Waynesburg)	0	0

Washington section in the Ralph hoisting shaft

Thickness Ft.	Thickness in.	Strata	Name	Above top of Waynesburg coal Ft.	Above top of Waynesburg coal in.
14		Yellow and blue clay (surface)			
4		Shale			
1		Limestone	(Bristol limestone ?)		
8		Black shale			
1	6	Limestone			
6		Black shale			
1	6	Limestone			
6		Black shale			
1	6	Limestone			
2		Plastic clay			
7		Black shale			
3		Coal	(Little Washington)	128	5
4		Sandstone and shale	(Upper Mannington)	124	5
11	6	Black shale			
2		Coal	(Waynesburg B)	110	11
6		Sandstone	(Lower Mannington)	104	11
5		Black shale			
6		Gray limestone	(Woodglen)	93	11
1	6	Plastic clay			
8	6	Sandstone			
4	6	Black shale			
5	6	Sandstone			
4	6	Black shale			
1	2	Plastic clay			
7	3	Limestone	(Mt. Morris)	61	0
3		Gray sandstone			
10		Black shale			
1	6	Limestone	(Lower Mt. Morris)	46	6
1		Plastic clay			
5		Shale			
5	6	Gray shale			
5		Black shale			
4		Coal	(Waynesburg A)	26	0
4	5	Limestone			
4	1	Plastic clay			
4	6	Limestone	(Elm Grove)	13	0
13		Plastic clay	(Cassville)	0	0
		Coal	(Waynesburg)	0	0

Washington section in Ralph air shaft

Thickness Ft.	in.	Strata	Name	Above top of Waynesburg coal Ft.	in.
14		Yellow and blue clay (surface)			
9		Shale			
3	2	Limestone	(Lower Washington limestone)	171	5
4		Shale			
1	10	Plastic clay			
5	7	Limestone			
0	11	Plastic clay			
1		Limestone			
14	11	Shale			
4		Coal	(Washington)	152	6
6		Shale			
1	10	Limestone	(Bristol)	144	8
14	3	Black shale	(Little Washington coal ?)	130	5
2	5	Sandstone	(Upper Mannington)	109	11
6		Shale			
1	6	Sandstone			
5	7	Shale			
5		Sandstone			
1		Shale			
1	6	Coal and slate	(Waynesburg B)	107	5
1		Shale			
11		Limestone and shale	(Woodglen)	85	11
3		Gray limestone			
6	6	Light limestone			
4	6	Shale			
3	6	Limestone	(Colvin Run)	70	5
1	6	Clay			
6		Limestone			
8	6	Black shale			
1		Plastic clay			
3		Coal	(Waynesburg A)	57	11
4		Sandstone			
7	6	Shale			
2	6	Plastic clay			
3		Gray limestone	(Lower Mt. Morris)	40	11
4		Gray shale			
3	11	Plastic clay			
1	5	Black shale			
8		Plastic clay			
2	7	Sandstone	(Waynesburg)	21	0
7		Plastic clay			
14		Shale	(Cassville)	0	0
		Coal	(Waynesburg)		

Washington section in Filbert air shaft

Thickness		Strata	Name	Above top of Waynesburg coal	
Ft.	in.			Ft.	in.
7	3	Shale			
5	3	Limestone and black shale	(Lower Washington)	183	0
14	9	Black shale			
4		Coal	(Washington)	164	3
19		Black shale			
3		Coal	(Little Washington)	142	3
20		Gray shale			
1		Coal	(Waynesburg B)	121	3
11		Gray shale			
9		Gray limestone	(Woodglen)	101	3
10		Gray shale			
3		Plastic clay			
7		Gray limestone	(Colvin Run)	81	3
18	3	Gray shale			
2	6	Coal	(Waynesburg A)	60	6
24		Gray shale			
9		Sandstone	(Waynesburg)	27	6
4	6	Black shale and clay			
5		Plastic clay			
18		Gray shale and clay	(Cassville)	0	0
		Coal	(Waynesburg)		

Washington section in Brier Hill shaft

Thickness		Strata	Name	Above top of Waynesburg coal	
Ft.	in.			Ft.	in.
3		Surface			
9	3	White sandstone	(Upper Marietta)	257	5
	7	Coal	(Washington A)	247	5
8	10	Plastic clay			
	7	Coal			
4	6	White sandstone	(Middle Marietta)	226	5
3	5	Gray sandstone			
	10	Coal			
12	3	Sandstone			
1		Limestone	(Blacksville)	211	3
4	8	Black shale			
4	10	Limestone			
2	11	Limestone and coal			
1	9	Limestone and clay			
4	3	Sandstone		204	0
3		Coal	(Lower Marietta)	191	10
12	2	Sandstone			
1		Limestone	(Lower Washington)	177	3
4	8	Black shale			
4	10	Limestone			
4	1	Limestone and coal			
7	6	Clay			
4	3	Sandstone			
3		Coal	(Washington)	162	6
25		Black shale			
3		Coal	(Little Washington)	134	6
1	2	Shale			
6	8	Sandstone	(Upper Mannington)	126	8
2	3	Coal and black shale	(Waynesburg B)	124	5
	10	Sandstone			
2	2	Limestone	(Woodglen ?)	121	5
47	6	Sandstone	(Lower Mannington)	73	11
9		Limestone	(Colvin Run)	64	11
	8	Sandstone			
4	4	Coal and black shale	(Waynesburg A)	59	11
6		Plastic clay			
5	6	Sandstone	(Mt. Morris)	48	5
13	6	Plastic clay			
12		Sandstone	(Waynesburg)	0	0
2		Limestone			
1	4	Shale and sandstone			
4	10	Sandstone			
1	1	Black limestone			
13	8	Sandstone			
		Coal	(Waynesburg)		

Washington section in Buffington shaft

Thickness		Strata	Name	Above top of Waynesburg coal	
Ft.	in.			Ft.	in.
8	6	Surface			
1		Clay			
	10	Coal	(Waynesburg A)	51	6
1		White clay			
1		Limestone	(Upper Mt. Morris)	49	6
2		Shale			
2		Sandstone	(Mt. Morris)	45	6
10		Limestone	(Lower Mt. Morris)	35	6
35	6	Shale and plastic clay	(Cassville)	0	0
		Coal	(Waynesburg)		

Washington section in Sarah hoisting shaft

Thickness Ft.	Thickness in.	Strata	Name	Above top of Waynesburg coal Ft.	Above top of Waynesburg coal in.
15	2	Yellow clay (surface)			
18	1	Sandstone	(Waynesburg)	4	6
3	10	Black shale			
3	11	Gray shale			
10	8	Gray sandstone			
	5	Shale			
11		Blue sandstone			
4	6	Limestone and shale	(Elm Grove)	0	0
		Coal and sandstone	(Waynesburg)		

Washington section along the National Pike from west of Searights to west of Brier Hill

Thickness	Strata	Name	Above top of Waynesburg coal
	Thin bedded sandstone and shale		
10	Limestone	(Upper Washington)	400
15	Massive sandstone	(Brier Hill)	385
10±	Concealed		
10	Sandy shale		
1	Sandstone		
15	Shale		
1	Coal	(Jollytown)	338
12	Sandstone	(Jollytown)	326
25±	Concealed		
2	Sandstone		
8	Shale		
5	Limestone	(Middle Washington)	286
15	Sandstone	(Upper Marietta)	
50	Concealed		
6	Limestone	(Blacksville)	215
10	Sandstone	(Lower Marietta)	
10	Shale		
1	Coal	(Washington Rider)	194
3	Limestone	(Lower Washington)	191
10	Sandstone		
9	Shale		
2	Coal and slate	(Washington)	170
20	Sandy shale		
10	Sandstone	(Washington)	140
4	Concealed		
2	Coal	(Little Washington)	134
18	Sandstone and sandy shale	(Mannington)	116
4	Clay shale		
4±	Concealed		
2	Limestone	(Woodglen)	106
12	Sandy shale		
6	Clay shale		
8	Limestone	(Colvin Run)	80
2	Hard sandstone		
12	Sandy shale		
6	Concealed		
2±	Coal	(Waynesburg A)	58

Age and correlation. The Washington group is commonly believed to be Permian in age. Correlation is difficult because invertebrate fossils are almost entirely lacking in the group and its underlying strata and plant fossils are the only guide to the age. There appears very little doubt that the upper part of this group is Permian in age, as it contains several species of plants that are exclusively Permian in Europe and elsewhere, but there is much question as to where the lower boundary of the Permian should be placed. In the past it has been placed at several horizons ranging from the Washington coal to the Ames limestone of Conemaugh time. Most commonly it is placed at the Waynesburg coal, partly on the basis of plant remains and partly because a break in sedimentation and an unconformity at the base of the Waynesburg sandstone are thought by some geologists to occur at this stratum.[22] In most of Fayette County the depositional change is less marked than in other regions. However, in Luzerne Township (see measured sections for Sarah shafts among the Monongahela and Washington sections) a very marked increase in the amount of sandstone takes place, but the lower extent of this abundant sandstone lies well below the horizon of the Waynesburg coal and not far above that of the Uniontown coal. It seems to the writer that any definite location of the lower boundary of Permian strata can be determined only by a thorough investigation of the plant remains throughout the Monongahela and Lower Washington groups, but exposures are few and poor.

Washington section in Leisenring No. 3 shaft

Thickness Ft.	Thickness in.	Strata	Name	Above top of Waynesburg coal Ft.	Above top of Waynesburg coal in.
3	6	Soil			
9	3	Dark shale			
1	8	Coal	(Washington Rider or Washington A?)	182	5
1	6	Shale			
6	0	Limestone and clay			
6	0	Sandstone			
7	0	Sandy clay			
43	6	Sandstone			
0	6	Black shale			
0	6	Coal	(Little Washington or Washington ?)	116	5
11	6	Sandy shale			
1	0	Coal	(Waynesburg B or Little Washington ?)	103	11
6	0	Shale			
2	0	Sandstone			
7	6	Dark shale with sandstone lens			
0	4	Coal	(Waynesburg A or B ?)	88	1
48	10	Sandstone	(Waynesburg ?)	39	3
20	0	Limestone		19	3
17	10	Sandstone	(Waynesburg)	1	5
1	5	Shale	(Cassville)	0	0
3	4	Coal	(Waynesburg)		

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[22] Fontaine, Wm. M., and I. C. White, Upper Carboniferous flora of West Virginia and southwestern Pennsylvania: Pennsylvania 2d Geol. Surv., rept. PP, pp. 108-120, 1880.

This is one of the measured sections available in the Uniontown-Connellsville district and is given to show the character of the lower members of the Washington group. The correlations are only suggested.

So that this report will be in agreement with all other published geologic work on western Pennsylvania, the base of the Permian is placed at the top of the Waynesburg coal coincident with the division between the Washington and Monongahela groups. This boundary is purely arbitrary and based more or less on the relative importance of the coals in the section.

Cassville shale. The Cassville shale was named from Cassville, Monongalia County, West Virginia,[23] where a remarkable number of species of fossil plants as well as many fossil insects have been found in it. The Cassville shale lies on top of the Waynesburg coal and below the Waynesburg sandstone, from which it is separated in a few places by the Elm Grove limestone. An unconformity below the Waynesburg sandstone is indicated in places by the fact that the Cassville shale was removed by erosion previous to deposition of the sandstone. The shale itself ranges from a carbonaceous laminated shale, usually at the base, through clay shale to a sandy shale. The content of clay material is always high, and fresh exposures are rare because the shale weathers rapidly. The shale ranges in thickness from a few inches to many feet, but in places is entirely lacking. Extreme variation of thickness may take place in a short horizontal distance.

At many places in Fayette County where this shale was observed abundant plant remains were found. In all cases specific identification was not possible owing to the weathered character of the outcrops; only a little weathering is necessary to destroy the fine nervation, leaving only the rough outline of the leaves.

Several publications[24] give lists of the different plants that have been identified from remains found in the Cassville shale. No insects were found at this horizon in the county, but no extended search was made for them. The insects found at Cassville and studied by S. H. Scudder include several genera and many species of cockroaches.[25]

Elm Grove limestone. The Elm Grove limestone received its name from Elm Grove, West Virginia, where it is 10 feet thick and crops out abundantly.[26] In Fayette County the limestone was not seen in outcrop, but is reported from about one-third of the mine shafts which cut its horizon in the Klondike district. It lies above the Cassville shale and below the Waynesburg sandstone, and where present ranges from 1 to 4 feet thick. Its base averages about 13 feet above the top of the Waynesburg coal.

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[23] Fontaine, Wm. M., and I. C. White, op. cit.

[24] Fontaine, Wm. M., and I. C. White, op. cit.
White, I. C., Report on coal: West Va. Geol. Surv., vol. II, pp. 119-123.
White, David, Permian elements in the Dunkard flora: Geol. Soc. America Bull., vol. 14, pp. 528-542, 1904.

[25] White, I. C., loc. cit.
Scudder, S. H., Revision of American fossil cockroaches with description of new forms: U. S. Geol. Survey Bull. 124, p. 14, 1895.

[26] Grimsley, G. P., West Va. Geol. Survey County Reports: Ohio, Brooke and Hancock counties, pp. 68-69, 1906.

Waynesburg sandstone. The Waynesburg sandstone was named by H. D. Rogers (1858) from exposures in the vicinity of Waynesburg, Greene County. It lies between the Mt. Morris limestones and the Cassville shale where it is not separated from the latter by the Elm Grove limestone. In a few places it rests directly on the Waynesburg coal and the intervening Cassville shale has been removed by erosion. In the Uniontown-Connellsville area the sandstone is well developed and ranges from 10 to 45 feet thick, averaging about 25 feet. Commonly it is a medium-bedded, brown, micaceous sandstone composed predominantly of limonite-stained quartz grains and light-colored mica. Cross bedding is present, but is not conspicuous.

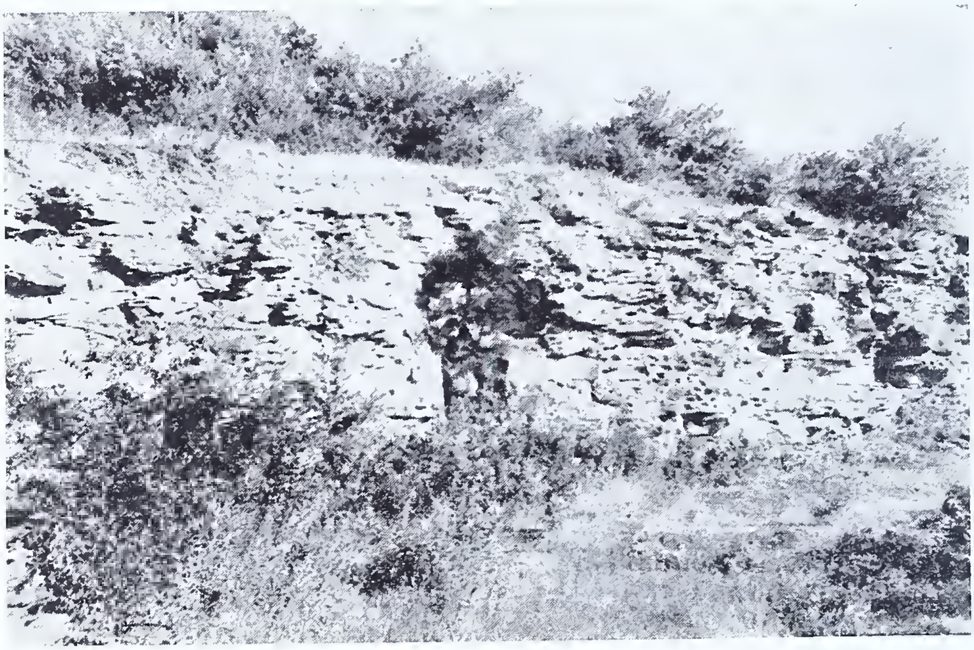

Figure 33. Waynesburg sandstone quarry at Monarch.

In the Klondike district many of the sections given in this report show the Waynesburg sandstone to be thin or entirely lacking, its place being taken by shale, clay shale, and thin limestone beds. This does not give a true picture of the district, as all the shaft sections given, except the Sarah, are located along the Lambert syncline. In the western part of the Klondike the strata lie higher and this sandstone crops on most of the hillsides. Many of these crops show it to be a heavy-bedded or massive brown micaceous sandstone of considerable thickness. Thus it becomes evident that the Waynesburg sandstone is extremely variable in character and thickness, ranging from 10 to 45 feet, and averaging about 25 feet. Owing to the unconformity, the interval between its base and the top of the Waynesburg coal ranges from 0 to 35 feet and averages 16 feet. The sandstone has been opened in many quarries in German, Luzerne, Redstone, Brownsville, Jefferson, North Union and Dunbar townships.

Lower Mt. Morris limestone. The Mt. Morris limestone was named by I. C. White (1891, pp. 39-40) from Mt. Morris, Greene County, where it crops out a few feet below the Waynesburg A coal. In Fayette County this limestone occurs in two beds separated from each other by shale or sandstone. They are here designated as the lower and upper Mt. Morris limestones. The lower bed is more persistent than the upper.

The Lower Mt. Morris limestone lies between the Waynesburg and Mt. Morris sandstones. In some places these sandstones come together and the limestone is cut out, in other places shale or clay shale may replace the limestone. The limestone is a light-gray homogeneous rock which breaks with a conchoidal fracture. Its hard, massive beds may be separated by a few inches to a foot of softer shaly limestone. Its thickness ranges from 0 to 10 feet and averages about 4 feet. It lies 40 feet above the Waynesburg coal in the Klondike district.

Mt. Morris sandstone. The Mt. Morris sandstone takes its name from the Mt. Morris limestones between which it lies. In character it is similar to the Waynesburg sandstone and only in places where the Lower Mt. Morris limestone is present can it be separated from the Waynesburg. In the Lambert synclinal area the average thickness is only 4 feet, and it lies about 45 feet above the Waynesburg coal. In other parts of Fayette County, owing to the non-development of the Lower Mt. Morris limestone, the sandstone was not identified.

Upper Mt. Morris limestone. The Upper Mt. Morris limestone lies between the Mt. Morris sandstone and the Waynesburg A coal. In character it is similar to its lower part. In the Klondike district it averages 3 feet thick and lies 50 feet above the Waynesburg coal.

Waynesburg A coal. The Waynesburg A coal was named by J. J. Stevenson from its position in relation to the Waynesburg coal.[27] This coal lies between the Mt. Morris and Colvin Run limestones and is commonly separated from each of them by clay or shale. The coal is usually of poor quality, containing much bone and slate. In the Klondike it is a single bed 3 feet thick that lies 60 feet above the Waynesburg bed.

Colvin Run limestone. The Colvin Run limestone was named by I. C. White (1891, pp. 23 and 39) from exposures along Colvin Run, Greene County. In the Klondike district it is present in three-quarters of the measured sections, and was seen at many other places. It is composed of light and dark gray massive limestone beds often separated by light calcareous shales. It ranges in thickness from 0 to 12 feet, averages 5 feet, and lies 75 feet above the Waynesburg coal. It has been opened in several prospect pits but no quarries.

Woodglen limestone. In the Klondike region a limestone lies 20 to 25 feet above the Colvin Run limestone. It is commonly separated from the latter by clay shale or sandy shale, but in one case sandstone occurs between them. The limestone is well exposed in the Hugh

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[27] Stevenson, J. J., Report of progress in the Greene and Washington district: Pennsylvania 2d Geol. Survey, rept. K, pp. 45 and 56, 1876.

Murphy quarry just northeast of Woodglen, for which settlement it has been named. It is also shown in nearly all the shaft sections along the Lambert syncline. It is a gray to dark, fine-grained, homogeneous limestone that breaks with a conchoidal fracture. No fossils were seen in it. The thickness ranges from 0 to 10 feet and averages about 7 feet. It lies 95 feet above the Waynesburg coal.

Lower Mannington sandstone. The Mannington sandstone was named by G. P. Grimsley[28] from a quarry at Mannington, West Virginia. In most of northern West Virginia it is 30 to 50 feet thick and occupies the horizon of the Waynesburg B coal which has been cut out. In Fayette County the Waynesburg B coal is commonly present and lies in the middle of this sandstone. Therefore the sandstone is here divided into an upper and a lower part by this coal. The Lower Mannington sandstone lies between the Woodglen limestone and the Waynesburg B coal. Both parts are similar in appearance and consequently unless the Waynesburg B coal is seen, they are not distinguishable. The sandstone is brownish, medium to coarse grained and in some places fairly massive. The lower part is not as thick as the upper, ranging from 0 to 10 feet. It has an average thickness of 4 feet, and lies 105 feet above the Waynesburg coal in the Klondike district. The lower part is less massive than the upper.

Waynesburg B coal. The Waynesburg B coal was named by J. J. Stevenson[29] from exposures in Greene County. This coal lies between the two parts of the Mannington sandstone. The coal is of fair quality, but is too thin to be worked in the near future. In Fayette County it seems to be present in most places where its horizon is exposed, but southward in West Virginia it is cut out by the adjacent sandstones. The coal ranges from 6 inches to 2 feet in thickness and is in many places accompanied or replaced by black carbonaceous shale. It averages 1 foot thick and lies 115 feet above the Waynesburg coal in the Klondike district. It is not mined in the county.

Upper Mannington sandstone. The Upper Mannington sandstone lies between the Waynesburg B and the Little Washington coals. It is similar in appearance and character to the Lower Mannington, but is commonly more massive and thicker, ranging from 5 to 20 feet. In the Klondike region it averages 10 feet thick and lies 120 feet above the Waynesburg. It has been opened in a few quarries.

Little Washington coal. The Little Washington coal was named by J. J. Stevenson (K, p. 54) from exposures near Washington, Pennsylvania, where it lies not far below the Washington coal. In Fayette County this coal lies slightly farther below the Washington coal, but is quite similar in character, being a poor shaly coal associated with considerable black shale. In the Klondike it averages 2 to 3 feet thick and lies 135 feet above the Waynesburg.

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[28] Grimsley, G. P., Iron ores, salt and sandstone: West Va. Geol. Survey, vol. IV, p. 440, 1909.

[29] Stevenson, J. J., op. cit., p. 55, 1876.

Bristol limestone. The Bristol limestone was named by Ray V. Hennen[30] from its occurrence at Bristol, West Virginia. It is almost completely absent in Fayette County, but the Ralph shafts show thin limestone beds under the Washington coal which seem to be the equivalent of this West Virginia limestone. Nowhere else was it noted in Fayette County.

Washington sandstone. The Washington sandstone was named by J. J. Stevenson (K, pp. 53-54) from its association with the Washington coal, from which it is separated by a few inches of under clay. This sandstone occupies the interval between the Washington and Little Washington coals. In places it is replaced by sandy shale or clay shale and in the vicinity of the Ralph mine shafts by clay and limestone. The sandstone is thin-bedded, micaceous and gray. In many places it takes on a brown tint from the limonite produced by weathering. The mica is scattered all through the rock, but is especially abundant on the bedding planes. The sandstone ranges from 0 to 35 feet thick. Its thickness averages 10 feet in the Klondike district, where it lies 150 feet above the Waynesburg coal. It is opened in a quarry one mile west of New Salem.

Washington coal. The Washington coal was named by J. J. Stevenson (K, p. 51) from Washington County, Pennsylvania, where it is of economic importance. It lies between the Washington sandstone and the Lower Washington limestone. The bed is thick in some places, but the greater part is made up of shale and impure coal mixed and only the lowest part is good coal. In the Klondike area the horizon often exposes 2 to 4 feet of poor coal with numerous partings. It lies 170 feet above the Waynesburg coal.

Lower Washington limestone. The Lower Washington limestone was named by J. J. Stevenson from exposures in Washington County. It lies above the Washington coal and below the Washington Rider coal. The limestone is commonly dark, but may contain a few light buff beds and interbedded light gray calcareous shales. It ranges from 2 to 17 feet thick and averages about 10. The interval between it and the Waynesburg coal is commonly about 185 feet. No quarries are known on this horizon.

Washington Rider coal. The Washington Rider coal was named by Hennen and Reger[30] from its position above the Washington coal. This coal was known at an earlier date (K, pp. 50-51), but had never been named. It is a very thin bed. The maximum thickness observed was slightly under one foot, and the average is less than one-half foot. It lies 195 feet above the Waynesburg coal.

Lower Marietta sandstone. The Marietta sandstone was named by I. C. White (1891, pp. 35-36) from its occurrence at Marietta, Ohio, where it is extensively quarried for grindstones and other abrasive uses. He divided it into three parts, Upper, Middle and Lower, but he does not describe their limits. Ray V. Hennen[31] gives limits for the upper and lower parts, but as the middle part is not present in his type section it is not described. Hennen places the Upper Marietta sandstone immediately above the Washington A coal and below a calcareous shale (probably Middle Washington limestone). The Lower Marietta sandstone is located above the Washington coal and separated from it by a calcareous shale which represents the Lower Washington limestone. Above this sandstone comes 10 feet of limestone which Hennen calls the Middle Washington limestone, but which is obviously not Stevenson's Middle Washington limestone, as Stevenson and White have both placed this limestone above the Washington A coal. Instead, it is Stevenson's limestone III which White has named Blacksville limestone. The Middle Marietta sandstone of I. C. White naturally falls into the interval between the Washington A coal and the Blacksville limestone.

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[30] Hennen, R. V., West Virginia Geol. Survey County Repts., Doddridge and Harrison counties, pp. 168-9, 1912.

Hennen, R. V., and D. B. Reger, West Virginia Geol. Survey County Repts., Marion, Monongalia and Taylor counties, pp. 199-200, 1913.

The Lower Marietta sandstone is not conspicuous in Fayette County, being commonly a weak shaly buff to brown sandstone. It was seen on the National Pike and in the Brier Hill shaft. The shaft section shows 3 feet of poor coal in the sandstone, but this is believed to be a purely local coal, as it was not seen elsewhere at this horizon. In fact, all through this part of the Washington group sporadic local coal beds seem to be common. The sandstone ranges from 0 to 15 or 20 feet thick and averages about 10 feet. It lies 200 feet above the Waynesburg coal.

Blacksville limestone. The Blacksville limestone was known to J. J. Stevenson (K, p. 50), who called it Limestone III, and was named by I. C. White (1891, p. 36) for the village of Blacksville, West Virginia. The limestone ranges from gray to black and is similar to the other Carboniferous limestones. At the top of the Lambert shaft section this limestone is interbedded with clay and local coals which have replaced most of the limestone. Again in the Brier Hill shaft section a local coal is interbedded with the limestone. However, most sections do not show coal beds in the limestone, but merely alternate beds of limestone and calcareous shale. The thickness ranges from 5 to 20 feet and averages about 10 feet. The limestone lies about 210 feet above the Waynesburg coal.

Middle Marietta sandstone. The naming and position of this sandstone are discussed in the section on the Lower Marietta sandstone. The character of this sandstone is similar to the latter. It also contains local coal lenses, as do all the named strata in this part of the Washington group. Its thickness ranges from 5 to 30 feet and averages about 15. It lies 225 feet above the Waynesburg coal. No quarries are working this stratum.

Washington A coal. The Washington A coal was named by J. J. Stevenson (1876). It lies between the Middle and Upper Marietta sandstones. The bed is commonly double, having two layers of dirty coal less than one foot thick, separated by a carbonaceous shale or clay. The coals may be as much as 10 or 12 feet apart. Nowhere in Fayette County is the coal of economic value. It lies approximately 250 feet above the Waynesburg and 80 feet above the Washington coal.

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[31] Hennen, R. V., West Virginia Geol. Survey County Repts., Marshall, Tyler and Wetzel counties, pp. 215-218, 1909.

Upper Marietta sandstone. The position and naming of the Upper Marietta sandstone was discussed under the section on the Lower Marietta sandstone. This sandstone seems to be thicker and coarser than the Middle and Lower Marietta sandstones, and although it does not make an imposing show at the surface, it was seen cropping out in many places. It lies 260 feet above the Waynesburg coal and not far above the top of the Washington A coal.

Middle Washington limestone. The Middle Washington limestone was named by J. J. Stevenson (K, pp. 48-50) from its exposures in Washington County. It lies between the Davistown sandstone and the Upper Marietta sandstone. The limestone is composed of alternate beds of hard dark limestone and light gray calcareous shale. It ranges from a few to 10 feet in thickness and averages 7 or 8 feet. It lies 285 feet above the Waynesburg coal.

Davistown sandstone. The Davistown sandstone lies a short distance below the Jollytown coal and gets its name from a quarry on this sandstone just north of the National Pike at Davistown. It is highly probable that in parts of West Virginia where the Middle Washington limestone is lacking, this sandstone may have been included in the Upper Marietta, but from the type section given by Hennen, the Upper Marietta is confined to the sandstone lying below a calcareous shale which is the probable equivalent of the Middle Washington limestone rather than the bed so called in Hennen's section. Therefore, in a region where the Middle Washington limestone is well developed, it seems preferable that the Upper Marietta be confined to the sandstone strata below this limestone, and that the sandstone above it be given another name. The Davistown is a medium- to heavy-bedded, medium-grained, brown shaly sandstone which weathers fairly rapidly and produces a medium amount of float along its outcrop. It ranges from 10 to 30 feet thick and averages about 20 feet. It lies 320 feet above the Waynesburg coal. It has been opened in several quarries and is used for road base. The bedding is too irregular to produce good building blocks.

Jollytown coal. The Jollytown coal was named by J. J. Stevenson (K, p. 48) from Jollytown, Greene County, where it used to be mined for local use because of poor transportation facilities and lack of better coal. It lies between the Davistown and the Brier Hill sandstones. The coal is fairly pure, but its thickness is commonly less than one foot. It lies 340 feet above the Waynesburg coal.

Jollytown limestone. The Jollytown limestone of I. C. White (1891, p. 34) and Limestone V of Stevenson (K, p. 48) lying between the Jollytown coal and Upper Washington limestone was not observed in Fayette County.

Brier Hill sandstone. A sandstone was noted by J. J. Stevenson (K, p. 44) as lying directly below the Upper Washington limestone, but he did not name it. This sandstone is massive and well exposed in road cuts on the hilltop northwest of Brier Hill and is named for this settlement. The sandstone is heavy-bedded to massive, gray, coarse grained and only slightly micaceous in most of its outcrops. It ranges from 10 to 30 feet in thickness, and averages about 15 feet. It lies 370 feet above the Waynesburg coal. It is not quarried in Fayette County.

Upper Washington limestone. The Upper Washington limestone was named by J. J. Stevenson from its exposures in Washington County (K, pp. 45-47). It is the highest member of the Washington group and its top is taken as the boundary between this group and the overlying Greene group. The stratum is composed of two light-colored limestones separated by a darker middle portion, the whole interbedded with calcareous shale. The limestone ranges from 5 to 20 feet in thickness and averages 15 feet. Its top lies about 400 feet above the top of the Waynesburg coal. This limestone has been opened in several quarries and makes excellent agricultural lime when burned.

GREENE GROUP

The Greene group forms the upper part of the Dunkard series which was formerly called the Upper Barren Measures. It lies above the Washington group and is composed of the highest and youngest consolidated rocks in Fayette County. The group is Permian in age as determined from the plant fossils. The name Greene group comes from Greene County where these strata reach their maximum development in Pennsylvania. Only the lowest part of the group is preserved in Fayette County, so that is all of it that will be considered here. The base of the group is at the top of the Upper Washington limestone, and only shales and sandstone have been preserved above this stratum in Fayette County. The group has been divided into nine parts, only the lowest of which, the Donley sandstone, has been preserved in Fayette County.

Areal distribution. The Greene group is present only in the Klondike district. It lies in several small isolated patches on the highest hilltops along the Lambert synclinal axis. The northernmost of these areas lies just northeast of the National Pike on the hill north of Brier Hill. There are two small areas on the hills one to two miles east of Cardale and six areas on the crests of a line of hills running north and south from one mile east of Thompson No. 1 to half a mile southeast of Lambert.

Dunlap sandstone. J. J. Stevenson noted the presence of a sandstone about 10 feet above the top of the Upper Washington limestone in his Greene group section for Washington County (K, pp. 35-36). However, he did not name this sandstone. In this report it will be called Dunlap from Dunlap Creek just north of which it caps the hill two miles east of Republic. On this hill the sandstone is exposed better than elsewhere in the county, and is more than 30 feet thick.

It is a thin-bedded, brown micaceous sandstone showing little cross-bedding. The beds are ½ to 1 inch thick, and the mica is especially conspicuous along the bedding planes. The exposures show the sandstone ranging in thickness from 10 to 35 feet and averaging about 20 feet. The base of the sandstone lies 5 to 15 feet (average 10 feet) above the top of the Upper Washington limestone. The interval between is occupied by shale and clay shale which in places carry limonite concretions.

Above this sandstone the strata are commonly obscured where they have not been eroded, but in one or two places there are indications that sandy shales may be present.

QUATERNARY SYSTEM

Pleistocene

CARMICHAELS DEPOSITS

General account. The oldest of the unconsolidated deposits of Fayette County is the Carmichaels. The deposits, composed of gravel, sand, silt and clay, are in the abandoned meanders of the Monongahela and Youghiogheny rivers, and can be differentiated from the lower terrace deposits by their greater height above drainage and by the characteristic appearance of the meanders which they occupy. The name Carmichaels comes from the borough of that name in Greene County where a very thick and extensive deposit occurs. The material of the deposit is extremely varied and, except for a basal bed of coarse material, no sequence of deposition is discernible in the deposits, but rather the character of the material seems to have been dictated by the vagaries of stream flow. The deposits are up to 60 or 80 feet thick in a few places, but more commonly are thinner. They lie in the bottoms of the abandoned channels and may extend up the flanks as far as 100 feet above the bottom.

Areal distribution. The Carmichaels deposits are located along the two main rivers of the county. Along the Monongahela River there is a large deposit south of New Geneva and another encircling Masontown. Small deposits occur at Brownsville and east of Marchandsville, and large deposits are found in a circular valley south of Gillespie and at Fayette City, Fairhope, Lynnwood, and Bellevernon. Along the Youghiogheny River they occur at Sitka, at South Connellsville, on both sides of the river at Connellsville, and at Dawson, East Liberty, Perryopolis and southeast of Banning. Besides those mentioned above there are several very small patches of gravel which probably belong to this deposit.

Age and correlation. Although the Carmichaels contains no glacial material it is commonly believed that the deposition took place about the time of the earliest glacial invasion of the region north of the county. Very extensive drainage changes were caused by the ice invasion and it seems probable that the abandonment of the large meanders of Carmichaels age coincides in age with the drainage changes to the north. Fossil leaves have been found in the clays of this formation outside of the county and are said to be Pleistocene in age.

Origin. Two hypotheses have been advanced for the deposition of the very thick deposits of the Carmichaels. One proposes a general damming of the whole drainage system by the glacial front, thus causing ponding of the river waters on a large scale. The other postulates local dams caused by ice jams in the river bed which backed up the water sufficiently to cause local filling of the channel and then brought about a readjustment of the river course by diversion some distance above the dam, thus preserving the deposits from erosion. Neither of these hypotheses is entirely satisfactory, but the fine grain size and laminated character of some of the Carmichaels clays indicates clearly that there must have been deposition in ponded waters. It seems more probable that the second hypothesis was the major cause of the very thick deposits, but it is possible that a general ponding may have taken place and added to the effect of the local ponding.

HIGH TERRACE DEPOSITS

At some distance below the base of the Carmichaels and well above the present river alluvium, gravel deposits occur along the valleys of the Youghiogheny and Monongahela rivers. These deposits are not of large extent and are generally plastered along fairly steep valley sides. Unlike the Carmichaels the terrace gravels are not confined to the area west of Chestnut Ridge but also occur along the banks of the Youghiogheny River in the Ohiopyle Valley and in its gorge through Laurel Hill. The material composing the deposits invariably is gravel mixed with coarse sand, and very rough stratification is commonly noted. Whether the material came from reworking the Carmichaels or was brought down by the rivers from the mountains farther up stream could not be determined. The age of these terrace gravels is thought to be late Pleistocene.

Recent

LOW TERRACES AND ALLUVIUM

Along the courses of the Monongahela and Youghiogheny rivers as well as along some of the smaller streams such as Jacobs Creek, Redstone Creek, Dunlap Creek and Cheat River there occurs a deposit of sand, gravel and silt. In places these deposits occupy the flood plains of the streams and in others they are high enough above the stream bed to form low terraces above the flood plain. The material ranges from fine silt and mud to coarse gravel, and has been built up wherever the velocity of the streams has been slowed, whether because of a hard sandstone in the stream bed impeding the flow, or because of a curve in the channel causing an eddy. In the large rivers the usual cause of deposition is an eddy, although at Victoria and Bidwell on the Youghiogheny River in its gorge through Laurel Hill the main cause of deposition seems to be the Pocono and Pottsville sandstone barriers crossing the river below Victoria. Eddies caused by the stream swinging away from one of its banks merely add to the other agency of deposition.

The deposits along the smaller streams on the other hand are nearly all caused by sandstone barriers. Examples are the large, swampy alluvial flats northeast of Five Forks, Wharton Township, where the Mahoning sandstone has dammed Feik Creek; the swampy alluvial flats along Jacobs Creek from one mile above Stauffer to Tyrone Mills, where the Upper Mahoning sandstone has dammed Jacobs Creek; the alluvial flats along Redstone Creek from one mile below Vance Mill to Rothrock, where the Morgantown sandstone has dammed Redstone Creek; and the alluvial flats along Dunlap Creek from New Salem to Republic where the Waynesburg sandstone has dammed Dunlap Creek.

IGNEOUS ROCK

Only one representative of the igneous rock group is known in Fayette County. In the western part of the county, a small dike of ultrabasic rock has been known for many years. However, it appears to be a solitary occurrence and although there might be other dikes which are as yet undiscovered, this seems unlikely in the near vicinity of the known dike because the extent of mining on the Pittsburgh coal is so great that any dike would have been found where it cuts this coal bed, though it might remain hidden at the surface.

Peridotite porphyry

GENERAL ACCOUNT

Two dikes of ultrabasic igneous rock occur in German Township near the mine settlement of Gates. The dikes are exposed in the Gates and Edenborn mines on the Pittsburgh coal and also crop out on the surface above the mine where several exposures were seen by the writer. The most complete data and exposures are obtainable underground in the mines, where two parallel dikes 100 feet apart extend in a northwest-southeast direction. Their dip is approximately vertical. The larger dike lies on the southwest and is approximately 3 feet thick although it thins in places to 1 foot and thickens to as much as 20 feet. The smaller dike is discontinuous and averages only 4 inches thick, but in places may be nearly 1 foot thick. Both dikes are traceable through the mine workings for a distance of nearly 2 miles in which neither of them deviates greatly from their general strike.

At the surface two parallel dikes were not recognized and it seems probable that only one is present although this could not be absolutely established because of the scattered character of the outcrops. The average thickness of the dike is about 10 inches and the maximum and minimum observed were 20 and 4 inches. The dike is traceable for several hundred yards on the surface but not for the full extent of the exposures in the mine. No outcrops of it were seen at the tops of the hills it cuts through, but due to the thickness of the soil cover it could not be determined whether it had penetrated the higher strata forming the hilltops.

The extent and shape of the dike and the character of the rock have been discussed extensively in two earlier papers, one by Kemp and Ross (1907) and the other by L. B. Smith (1913). In the latter a great amount of detail is given on the location, shape and size of the dike and its relation to the Pittsburgh coal bed in the Gates and Edenborn mines. The first paper is less detailed in the description of the extent and boundaries of the dike but gives a more complete microscopic study and a chemical analysis of the rock. In the present work specimens were collected from the dikes, and the following description is based on a study of thin sections.

PETROLOGY

The dike is an ultrabasic rock which might well be called biotite-peridotite porphyry. In character it is very close to alonite except for the fact that no melilite was found in the thin sections and that the content of alkalies is slightly lower than in the rock at Alnö, Sweden. In chemical composition the rock is very close to the average, compiled by Daly,[32] for mica periodotite, the chief difference being the larger amount of carbonization that has taken place in the Fayette County rock.

The peridotite is a hard massive rock which when fresh presents a sparkling black appearance. The weathered surface is brown and very rough, owing to the resistance to weathering of the numerous inclusions which form projections and the rapid weathering of some of the constituents which form pits. The inclusions which are very abundant in places are chiefly shale, limestone and coal. One thin section shows many rounded sand grains which have been derived from one of the sandstones through which the dike cuts. The shale inclusions commonly show some effects of heat and pressure, but have not been altered to a hornfels. The limestone does not show any notable change. The coal has had part of its volatile matter driven off and has lost its luster, having the appearance of a very low-grade coke.

The mineralogy of the dike could be studied only by means of the microscope because the grain size is too small for individual mineral grains to be recognized in hand specimens. The predominant minerals are olivine, serpentine, biotite, calcite-dolomite and black opaque minerals which probably include ilmenite, perovskite and magnetite. In addition there are pneumatolitic minerals such as garnet and chlorite, and sedimentary rock mineral inclusions which will be discussed in more detail below.

The texture of the rock is distinctly porphyritic, but is in part obliterated by the extensive alteration which has affected most of the dike. The phenocrysts are composed of biotite, opaque minerals and olivine or its alteration product, serpentine. The groundmass is largely calcite-dolomite which may or may not be an alteration product. The phenocrysts range from microscopic in size to a few scattered individuals of biotite and serpentinized-olivine half an inch or more in diameter. The groundmass is composed of anhedral calcite-dolomite. The calcite individuals vary greatly in size, some being as large as the phenocrysts they surround, whereas others are very much smaller.

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[32] Daly, R. A., Igneous rocks and the depths of the earth; McGraw-Hill Book Co., New York, p. 20, 1933.

Olivine. Olivine occurs in the rock only as phenocrysts. Commonly it is so extensively altered to serpentine and iron-bearing minerals that only the original outlines of the phenocrysts are preserved, but in places some individuals have been only partly replaced and one section shows abundant phenocrysts that are completely unaltered. The phenocrysts of olivine are larger and more numerous than the biotite phenocrysts, constituting about twice as much of the rock as the biotite.

The alteration of the olivine appears to be hydrothermal in character and although it may have taken place while the magma was still liquid, this seems less likely than that the mineral was altered after solidification because of the varied extent of the change in different parts of the rock, which could be brought about more easily in solid rock than in partially solidified magma. The common form of alteration is a complete serpentinization of the phenocrysts which has developed progressively from the periphery and along cracks in the olivine. During the serpentinization small amounts of an iron mineral, probably magnetite, have separated out and are located largely around the peripheries of the phenocrysts. The small amount of the iron compared with the serpentine that was produced during alteration indicates a low-iron, high-magnesian olivine near the fayalite end of the solid solution series.

Serpentine. All of the serpentine in the rock is an alteration product of olivine. Serpentinization has not affected any of the other minerals. Serpentinization of the olivine has taken place very extensively throughout most of the rock and it is the exception, rather than the rule to find any of the olivine remaining. In a few serpentinized-olivine phenocrysts, calcite has replaced part of the serpentine.

Biotite. Biotite is one of the chief components of the peridotite porphyry. It occurs as phenocrysts but was not recognized in the groundmass. The phenocrysts commonly are microscopic, being half as large as those of olivine, but large individuals up to 1 cm. in diameter are scattered at rare intervals through the rock. None of these were seen in thin section, but they appear to be the same type of biotite as the small phenocrysts. The biotite of the small phenocrysts is brown and its pleochroism ranges from light tan to deep brown. Cleavage cracks are not prominent in thin section and are parallel to the total extinction under crossed nicols. 2 V is very small and the biotite is nearly uniaxial. The individuals have sharp euhedral boundaries which show little or no corrosion and the biotite appears very fresh.

Calcite-dolomite. Calcite and associated dolomite are among the most abundant minerals in the peridotite porphyry. The separate determination of the two carbonates in thin section is always very difficult and in this rock where they are intimately intermingled and commonly cloudy from impurities it is even more so. Therefore they are put in one group here and will be discussed together.

The calcite-dolomite is not all of the same generation but was deposited in at least two and possibly more periods. Small amounts of these minerals have in part replaced the serpentine and fill cracks in the rock. In these occurrences the calcite-dolomite is not much clouded and is clearly of hydrothermal origin. Most of the calcite-dolomite, however, is in the groundmass of the rock. These minerals form a fine-grained cloudy aggregate between the phenocrysts. The calcite-dolomite in the groundmass has been cut by later cracks which are filled with the second generation hydrothermal calcite-dolomite. In origin the earlier calcite-dolomite might be either primary or a hydrothermal replacement of volcanic glass. The hydrothermal origin of the calcite-dolomite groundmass is favored because the groundmass of the dike is all carbonate, and since the groundmass represents all the liquid part of the rock at the time of intrusion it seems to the writer that such a melt of pure carbonate carrying phenocrysts is not possible, as has been pointed out by Bowen.[33] On the other hand many things point to a primary origin for these carbonate minerals. Daly[34] cites many examples where well-known European geologists have considered carbonate minerals in basic igneous rocks to be primary constituents of the rock. Furthermore, absolutely fresh olivine occurs in contact with groundmass calcite-dolomite and if the carbonates were hydrothermal it is very difficult to believe that the water-rich solution that brought in the carbonates would not appreciably alter the olivine to serpentine. Also, nowhere in any section examined was a vestige of a glassy groundmass seen, indicating a complete carbonization of the glass with very little effect on the other ingredients.

Opaque minerals. Besides the secondary magnetite produced in the serpentinization of the olivine a considerable amount of opaque material is present in the rock. The minerals ilmenite, perovskite and magnetite were recognized, but owing to the difficulty of identifying them in thin section their relative abundance could not be determined. They occur in rounded or flattened grains varying in size from nearly as large as the average olivine to much smaller than the biotite or olivine phenocrysts.

Garnet. Large to medium-sized, deep red euhedral crystals of garnet are scattered irregularly through the rock. The garnets are surrounded by serpentine and chlorite. Similar garnets occur in the invaded country rock. These two facts lead to the conclusion that the garnet is secondary in origin, having been produced by the pneumatolysis that followed the solidification of the dike.

Chlorite. A very small amount of chlorite was seen scattered through the peridotite. It was not seen replacing the biotite, but rather associated with the serpentine replacement, with peripheral garnet alteration, and as a hydrothermal alteration along the dike border. In each case it is the product of hydrothermal alteration and not a primary constituent of the rock.

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[33] Bowen, N. L., The Fen Area: Amer. Jour. Sci., vol. VIII, no. 43, pp. 1-11, 1924. Carbonate Rocks of Fen Area: Amer. Jour. Sci., vol. XII, no. 72, pp. 499-502, 1926.
Origin of Ultrabasic and Related Rocks: Amer. Jour. Sci., vol. XIV, no. 80, pp. 89-108, 1927.

[34] Daly, R. A., Op. cit., pp. 864-5.

Chemical analysis. A chemical analysis of the dike was published by Kemp and Ross (1907, p. 517). It is repeated below along with the norm calculated from it. Its classification in the quantitative system places it in class IV, order 2, section 2, range 2 and subrange 2. The probable hydrothermal addition of carbonate to the original rock makes this classification rather doubtful.

Biotite-peridotite porphyry from Fayette County

Chemical analysis Analyst, M. W. Adams		Norm	
SiO_2	28.83	Orthoclase	7.78
Al_2O_3	2.94	Albite	6.29
Fe_2O_3	3.60	Anorthite	.56
FeO	5.13	Hypersthene	11.90
MgO	24.31	Olivine	28.28
CaO	11.24	Calcite	17.90
Na_2O	.75	Dolomite	7.48
K_2O	1.31	Apatite	2.02
H_2O+	3.96	Ilmenite	10.78
H_2O-	.83	Hematite	3.68
P_2O_5	.77	Water	4.79
TiO_2	5.67		
CO_2	11.64		

PNEUMATOLYSIS

Hydrothermal action has affected not only the dike itself but the wall rock for a few feet on each side of it. The major effect has been the addition of mineral matter and a minor effect a baking caused by heat from the dike. The addition of material within the dike and in the wall rock are quite similar, the same minerals forming in both places. The secondary calcite-dolomite that fills cracks in the dike is certainly pneumatolytic and was accompanied by a carbonization of the wall rock more noticeable where coal is intruded because of the white color of the introduced material, but present throughout the wall rock. Likewise garnet and chlorite have been produced in the dike itself and also in the wall rock.

The heating effects of the dike were slight on the country rock owing to the low temperature of the magma at intrusion. The coal has been partly coked but the sandstone and limestone have remained unaltered. The shale has been made harder and more brittle, which may be a result of heat but more probably is due primarily to the addition of carbonates.

AGE

The age of the peridotite porphyry cannot be told accurately. Since the intrusion cuts the Waynesburg sandstone, the dike is post-Pennsylvanian and because it ties in with structures developed in the Appalachian revolution probably it is later than the major development of Appalachian structure and so post-Paleozoic. How long a time after the close of the Paleozoic period had elapsed before the intrusion came in is impossible to say. Several geologists have suggested a connection with the Triassic vulcanism but it seems to the author that this assumption is not sufficient for more than a very tentative correlation and the age will be given here as post-Paleozoic, pre-Pleistocene (Carmichaels).

GEOLOGICAL HISTORY

The geological history of Fayette County may readily be divided into two parts, the first of which is characterized by the deposition of sediments, and the second by the partial erosion of the earlier deposited sediments. The history of the first period can be read from stratigraphy, whereas the second must be deduced from the physiography of the county and the surrounding areas.

Stratigraphic record

The stratigraphic record may be divided into three parts, pre-Cambrian time, Paleozoic time up to the Chemung period, and the time represented by rocks exposed at the surface in Fayette County. Any speculation on the character of the pre-Cambrian rocks underlying the county can have no basis of observation and so nothing can be said of pre-Cambrian historical geology except that nothing is known about it. The Paleozoic rocks lying below Fayette County, but not exposed at the surface, have been discussed in a preceding section. Since the knowledge of them is of such a general nature it will suffice to say that during this time Fayette County was a part of the Appalachian geosyncline which was gradually sinking below the sea and being filled with mud, sand and calcareous deposits almost as fast as it sank.

The oldest rocks exposed in the county belong to the Devonian system, above which lie Mississippian, Pennsylvanian and Permian strata in the order named. The geologic history of this part of the record is more completely known than that of any other part of the stratigraphic record and will be discussed under the following subheads:

Chemung and post-Chemung eras. The exposed Devonian rocks of Fayette County are greenish-gray shales and vari-colored sandstones which contain marine fossils, and red shales and gray and brown sandstones without fossils. The sequence of these rocks is not entirely known because of the disconnected character of the outcrops, but the lowest beds are marine and were laid down when the sea covered Fayette County. They are overlain by red beds of deltaic or land origin which in turn are overlain by more marine strata. Thus these rocks give Chemung history as a time when a delta was built out into a sea occupying the position of the county, after which the delta was submerged and the sea again occupied the area. At the close of Devonian time the newly formed sediments were uplifted above the sea and some of the uppermost were eroded, as is attested by the unconformity separating the Devonian and Mississippian strata.

Mississippian period. The geological history of the Mississippian period may be read from the stratigraphy something as follows. The period was ushered in by the deposition of considerable quantities of sandstone (Pocono) which by its cross-bedding and the irregularity of the shale content probably was laid down in a shallow sea with strong currents. After a period of quiescence, uplift followed and the top sands, as yet unconsolidated, were subjected to æolian action, being blown around in dunes, with the possible addition of some material. With a slight lowerng of the land, sea water percolated through the unconsolidated sands, depositing calcium carbonate (possibly caused by evaporation of the water at the surface of the sands) and cemeting the sand into the Loyalhanna limestone. At about the same time and possibly overlapping the last of the cementation a second delta crept westward over the county, depositing the Mauch Chunk red and green shales and brown sandstones. The progress of the delta was interrupted for a while soon after it had covered the county by submergence of the newly formed land under the sea. During this submergence the Greenbrier limestone and associated gray marine shales were deposited. The interruption was not of great length and soon the delta was again being built. The last act of the Mississippian period was the complete emergence of the rocks and the erosion of a part of the red beds.

Pennsylvanian period. Pennsylvanian time began in Fayette County with the deposition of the Pottsville series in a shallow sea containing little or no animal life. The sea floor was raised above water level on several occasions and swamps with their abundant plant life were formed, only to be submerged again with further underwater deposition. With the close of Pottsville time the land was again raised above the sea, in which position it has remained ever since with the exception of two or three very brief periods in the early part of the Conemaugh epoch when submergence with the deposition of fossiliferous marine limestone and shale took place at the Brush Creek, Cambridge and Woods Run horizons. Throughout Allegheny, Conemaugh and Monongahela time, deposition and the reworking of material just deposited was going on throughout the county. Streams flowed over the land surface depositing mud and sand a good part of the time but were interrupted at intervals when swampy conditions predominated and peat accumulated (later to become coal) or clays and fresh-water limestones were deposited in inland lakes.

This deposition was not equally distributed throughout the county, however, but was controlled by several factors. The coarser sediments accumulated more extensively along the streams and finer material was deposited away from them. The greater part of the original irregularities of thickness, however, were removed by lateral planation and other erosion at the point of greatest thickness, which can be seen in the many local unconformities of the strata. After such planation it was usual for deposition to begin again with coarse material forming sandstone indicating the near-by presence of a stream, but some unconformities underlie shales, limestone and even coals or thin underclays, so that in many cases the near-by presence of a stream is not attested by sandy deposition at the close of a local erosional period.

Some of the irregularities in thickness of strata are more general than those cited above and were caused by conditions other than the vagaries of subaerial deposition. For instance, the Allegheny group is thinner along Chestnut Ridge than elsewhere in the county, whereas the Conemaugh is thicker east of Chestnut Ridge than west of it. Allegheny thinning along Chestnut Ridge took place by the elimination of much of the middle Allegheny deposition and it is believed that this is the result of the first stages of the Appalachian revolution. The feeble beginnings of the arching up of the great Chestnut Ridge anticline are believed to have formed positive areas in the middle of Allegheny time. The thickening of the Conemaugh east of Chestnut Ridge is not even throughout the sequence but occurs at definite places in the sequence and was caused by the introduction of members not found in the sequence west of the ridge. There are such great differences in individual members on the two sides of the ridge that it appears likely that the positive area along the ridge was effective intermittently throughout Conemaugh time, forming two separate depositional basins whenever additional elevation of the anticline took place. The Monongahela strata differ in much the same manner on each side of the Fayette anticline as do the Conemaugh across Chestnut Ridge and, following the same lines of reasoning, it seems logical to conclude that the moderate-sized Fayette anticline had become a positive area by Monongahela or early Permian time.

Permian period. Conditions of deposition at the beginning of the Permian were the same as at the end of the Pennsylvanian. No clear-cut break occurs in the strata and the boundary between the two is known only from the change taking place in the plant life. This change is gradual and it seems probable that the two periods grade into each other and that deposition continued in Permian time in exactly the manner described above for the Allegheny, Conemaugh and Monongahela epochs. How long Permian deposition continued in Fayette County after the deposition of the Dunlap sandstone early in the Greene epoch is not known as the stratigraphic record has all been removed above the Dunlap; however, it seems probable that it must have continued for a fairly long time as strata are preserved in near-by Greene and Washington counties that were deposited during a great part of the Greene epoch.

Appalachian revolution. At the end of the Paleozoic the sediments that had been accumulating so long in the Appalachian region yielded at last to lateral pressure and were compressed in great folds. This great change in physical conditions, the greatest change of its kind in earth history, is known as the Appalachian revolution. The Appalachian revolution marks the close of the stratigraphic record and brought about a great change of conditions in Fayette County. Contrary to an often expressed idea the revolution did not take place rapidly, nor at one time, but is spread over a period of many millions of years and, beginning slowly, gradually increased in intensity until the end of the stratigraphic record. It probably died out slowly, but nothing remains to tell the speed of the later stages.

In Fayette County the most obvious result of the revolution is seen in the great folds into which the once nearly horizontal strata have been pressed. Horizontal compression produced the folding and it seems probable that the active element of this force operated from the southeast as the greatest folds lie in that direction and a gradual diminution of magnitude takes place toward the northwest. The earliest record indicating the inauguration of the force can be seen in the beginning of the arching of the rocks along Chestnut Ridge during the laying down of the Kittanning formation of the Allegheny group. From this time on, repeated indications of the force are encountered until the close of sedimentation during the Greene epoch. However, the total amount of folding up to this point is meager when compared with that which has taken place since, and the time of maximum compression and folding as well as that of cessation of compression can be dated only as after the Greene epoch and late in the Permian period.

Physiographic record

During Mesozoic and Cenozoic time the whole Appalachian region has been a land area undergoing erosion. A Cretaceous submersion with deposition of sediments has been postulated by some investigators but since no direct evidence of it can be found it will merely be mentioned here as a possibility. The only part of the history of denudation that can be read is the very end of it and a great gap appears in the sequence which cannot be filled. What was happening in western Pennsylvania while the Triassic sediments were being laid down in eastern Pennsylvania, or during the Cretaceous and early Tertiary while most of the Coastal Plain deposits were formed will never be known in detail. During that time the land must have undergone a considerable amount of erosion which may have been continuous throughout the whole time but more probably occurred in several stages corresponding to an equal number of uplifts.

The end of the whole process of denudation is written in the present surface features of the county and helps in dating certain of the phases. The general concept of a summit peneplane of Cretaceous age for Pennsylvania has been generally accepted for many years by investigators in this State. The writer is in agreement that there has been such a peneplane but he does not ascribe to a Cretaceous age but rather would follow Ashley.[35]

The summits of Chestnut Ridge and Laurel Hill are often spoken of as representing the above mentioned peneplane but such does not seem to the writer to be the case. Detailed geological investigation on the top of these ridges shows the surface configuration to be controlled almost entirely by hard sandstone ledges. The ridge tops seem to represent a nearly level surface which has been developed by removal of the overlying soft beds. It might perfectly well be the trace of a peneplane lying at a higher elevation which has been lowered a few hundred feet by hilltop erosion since rejuvenation of the drainage which marked the close of the cycle producing the peneplane. In fact some evidence points to the former presence of such a peneplane. The Homewood sandstone which forms the capping of the ridges is entirely removed from them at two places. There the capping is the underlying Pocono sandstone. At both of these points structural highs raised the Homewood far above its elevation at any of the places where it now caps the ridges. The development of a peneplane which would remove the resistant Homewood at these points would explain its absence there much better than any theory based on greater elevation causing more complete erosion, as the differences in elevation are only about 400 feet. Therefore there is some evidence supporting a hypothetical peneplane over Fayette County in Miocene time at an elevation of 300 to 500 feet above the present ridge tops and which, if still preserved, would lie about 3,000 feet above sea level.

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[35] Ashley, Geo. H., Studies in Appalachian Mountain Sculpture: Bull. Geol. Soc. America, vol. 46, pp. 1403-4, 1935.

The extensive Allegheny peneplane of western Pennsylvania is supposed to be represented by the hilltops in the lowlands west of Chestnut Ridge. The writer could find no evidence for such a peneplane in drainage changes nor accordance of hilltops in Fayette County. The only drainage changes which are recognizable in the county must either be ascribed to stream piracy caused by rejuvenation subsequent to the summit peneplane or to the rejuvenation leading to the preservation of the Carmichaels stream meanders which lie far enough below the valley hilltops not to be associated with a peneplane drawn across their crests. The apparent even-crested character of these hills, when examined in connection with the rock forming them, leads only to the conclusion that they are erosion residuals which have been reduced in proportion to the hardness of their rocks from some peneplane lying far above, probably the postulated 3,000-foot plane. It therefore appears that erosion continued without an interruption of sufficient moment to leave its mark on the physiographic development from the time of the summit peneplane until the Carmichaels epoch.

Near the beginning of the Glacial (Pleistocene) period the major streams of the county were flowing in entrenched meandering courses across the county. A combination of several factors, which included regional climatic change and glacial blocking of the main drainage courses below the county, caused a cessation of downcutting and extensive silting up of stream courses in the county at the beginning of Carmichaels time. This was followed by renewed downcutting when the drainage had opened new outlets into the present Ohio River. With the rejuvenation and renewed downcutting many of the meanders of the old river were cut off and have been preserved, along with much of the filling that took place during Carmichaels time.

The geological history of the time since the Carmichaels is one of rejuvenated erosion, with the streams entrenching themselves. Terrace deposits have been formed by current eddies along the river valleys during their downcutting, but do not indicate a break in the orderly course of the erosion.

PART II. TOWNSHIP DESCRIPTIONS

GEOLOGY AND MINERAL RESOURCES BY TOWNSHIPS

The discussions of the geology and mineral resources of Fayette County are presented by townships for the purpose of giving more detailed descriptions and specific locations of the various natural phenomena encountered in each township than has been given in the more generalized county-wide descriptions of the same resources. This is especially true of the coal data. The discussions of the other resources are chiefly a rearrangement from a type to a geographic classification.

Method of location. The following method is used as a means of giving specific locations in the text that would be easily referable to the map. The topographic map is subdivided into small quadrilaterals of 2½ minutes latitude and longitude. These tiers of quadrilaterals are lettered with capital letters from west to east and with small letters from north to south. Locations made in each quadrilateral are numbered consecutively. As an illustration, the text location Oc6 will be found in the quadrilateral that is at the intersection of the north-south tier under the capital O, with the east-west tier opposite the small c. In the quadrilateral so located it is only necessary to find the corresponding number to have the exact map location.

Analyses. No analyses will be given in the township discussions. Coal analyses will be found in the chapter on that subject. The results of physical tests and chemical analyses on clay, shale, limestone, sandstone and iron ore will be given in the county-wide descriptions of those resources and will be mentioned only by sample number in the township text.

JEFFERSON AND WASHINGTON TOWNSHIPS

Introduction

Jefferson and Washington townships are discussed as one unit because of the similarity of outcropping strata and rock structure in each one. Jefferson Township adjoins Washington Township on the south. They occupy the northwest corner of Fayette County, extending south from the north county line to Redstone Creek and east from the Monongahela River approximately 5 miles.

The Monongahela River and its tributaries drain all of the area. Redstone Creek and its tributaries, Washwater and Crabapple Runs, drain the south portion of the area; Little Redstone Creek the middle portion and Downers Run the north portion. The west edge of the area is drained by numerous short runs which descend the steep bluffs fronting on the Monongahela River. These bluffs rise 350 to 450 feet above the river in less than half a mile to a series of knobs with elevations of 1,200 to 1,260 feet. The high knobs persist through the two townships, and back from the Monongahela River they show a tendency towards flat tops accompanied by a gradual elevation increase up to 100 feet greater than in the hills bordering the river. The flat-topped hills are best developed in a north-south line through the center of the area. Along Redstone Creek the valley sides rise rapidly 200 to 350 feet and the valley bottom is narrow in all except the lower part of its course where the stream flows through a steep-sided alluvial flat ⅛ to ¼ mile wide. The lower course of Little Redstone Creek has steep sides and narrow bottom; the middle course (Ec) flows through a wide (½ mile) flat Carmichaels deposit which has more gently sloping sides; and the upper course is narrow-bottomed with rather steep slopes rising from the stream. Downers Run has a narrow-bottomed, steep-sided lower course; the upper course has a relatively wider bottom and more gentle slopes. Flat areas of Carmichaels deposits in abandoned Monongahela River channels are found in the vicinities of Grindstone (Ed), Redstone (Ec), and Fairhope (Db). These deposits also form narrow terraces at scattered localities on the bluffs along the Monongahela River.

Transportation facilities for heavy materials consist of the Monongahela River, a line of the Pittsburgh & Lake Erie Railroad with spurs on Little Redstone Creek and Downers Run, and a line of the Pennsylvania Railroad along Redstone Creek. Most of the coal mined in these townships is loaded on barges on the Monongahela River for shipment to the north. Coal mining is the principal industry in the area and, although considerable Pittsburgh coal has already been removed, mining is still very active.

Structure

The structure in Jefferson and Washington townships is of the gentle rolling type and definite trends are poorly defined. The Port Royal syncline carries through the townships in an indefinite manner. The synclinal axis enters from the south near Chamouni (Cc) and rises 60 feet to a high point just southwest of Gillespie (Eb). From this high point it falls 100 feet to Lutz Run (Eb), where it leaves the area. The limbs of the Port Royal syncline have gentle slopes. The west limb rises a maximum of 60 feet per mile to the northwest and is better defined than the east limb, which has a maximum inclination of 50 feet per mile and is nearly non-existent near Gillespie (Eb). Next to the east, the Brownsville anticlinal axis enters the area west of Linn (Dd), falls 35 feet in 1½ miles and then rises 40 to 50 feet to a high at Little Redstone School (Eb), where this anticlinal disappears because of the junction of the Port Royal and Lambert synclines. Its west limb is poorly defined and has a minimum amplitude of 10± feet near Gillespie (Eb). The Lambert synclinal axis enters Jefferson Township just west of Grindstone (Ed) and rises 200 feet to near Quaker Church (Fc), where it leaves the area. This axis then follows a short distance east of the township line to Mill Run (Fb), where it merges into the Port Royal syncline. The Lambert syncline is best developed in the southeast corner of Jefferson Township, where the west limb rises 240 feet along Redstone Creek at a maximum rate of 120 feet per mile to the Brownsville anticlinal axis. The amplitude of the west limb decreases steadily as the synclinal axis is followed to the north to the junction of the Lambert and Port Royal synclines, where this limb ceases to exist. The portion of the east limb of the Lambert syncline that lies within the area under discussion is relatively flat close to the axis, but becomes increasingly steeper as the east line of Jefferson Township is approached.

The structure contour horizon in the area is the base of the Pittsburgh coal bed and the contour interval is 20 feet.

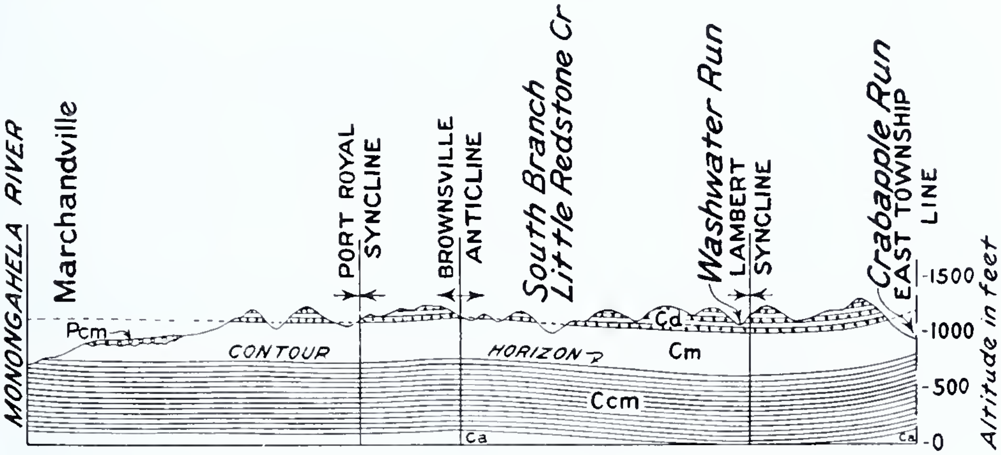

Figure 34. Structure section across Jefferson Township.

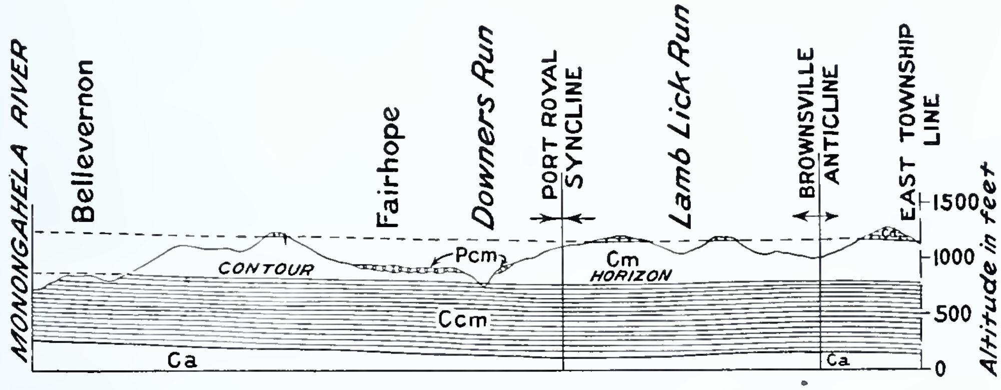

Figure 35. Structure section across Washington Township.

Legend. Pcm—Carmichaels deposits; Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation.

Stratigraphy

The exposed consolidated strata of Jefferson and Washington townships range in age from the middle Washington group of Permian time to the upper Conemaugh formation of Pennsylvanian time. They comprise a total stratigraphic section of 820± feet, which is divided into 160 feet of upper Conemaugh strata, 380 feet of Monongahela strata, and 280 feet of the lower Washington group. A few diamond drill holes just north and northwest of these townships give good sections of the unexposed Conemaugh and Allegheny formations and will be discussed later.

Unconsolidated sediments are represented by relatively large areas of Carmichaels deposits of Pleistocene time which lie in the abandoned channels of the Monongahela River, and by narrow alluvial deposits of Recent time which form the flood plains along the present major drainage.

PENNSYLVANIAN

Allegheny formation. The Allegheny formation is not exposed in Jefferson and Washington townships, but diamond drill holes near Gibsontown and Ohio City in Westmoreland County, and Charleroi in Washington County, give the general characteristics of this formation to be expected in these townships. Plotted sections of the diamond drill holes will be found at the end of this discussion of the stratigraphy.

The Upper Freeport coal is apparently a thick, mineable and persistent bed in the area. It is underlain down to the Lower Freeport coal by fire clay and shale. The Upper Freeport limestone ranges from 0 to 4 feet thick and has a sporadic occurrence. The Lower Freeport coal is a persistent but thin bed. Shale occupies the interval between the Lower Freeport and Upper Kittanning coals, although the Freeport sandstone may be developed locally. From the Upper to the Lower Kittannings, the interval is occupied by shale; below the Lower Kittanning, shale and fire clay persist for 120 feet to a coal believed to correlate either with or lie just above the Brookville bed. This correlation would make the Allegheny formation 265± feet thick in the area, and, as indicated by the drill records, composed mainly of shale with only thin and weak sandstone at the Freeport and Kittanning sandstone horizons.

Conemaugh formation. The upper part of the Conemaugh formation is exposed in the western halves of Jefferson and Washington townships in a continuous outcrop along the Monongahela River and the lower courses of Redstone Creek, Little Redstone Creek, Lamb Lick and Downers Runs. The greatest exposed thickness is 160± feet at Bellevernon (Da). The best exposures are in the river bluffs between Bellevernon and Fayette City, where the Little Pittsburgh coal lies between interbedded limestone and clay which comprise the Upper and Lower Pittsburgh limestones. Other exposures of the Conemaugh formation consist of drab shale and are too poor and too short to correlate. The diamond drill holes (Ca 1, 2; Da 1) just north and west of Bellevernon show a Conemaugh thickness of 625 to 640 feet. The formation consists chiefly of shale; only two of its sandstone members, the Mahoning and Morgantown, have their usual characteristics. The Buffalo, Saltsburg, and Connellsville sandstone members apparently are poorly developed and tend to be shaly, weak sandstones. The coals are all thin and have no value. In the diamond drill hole Da1, a fossiliferous limestone 4½ feet thick is reported 235 feet above the Upper Freeport coal. This limestone probably correlates with the Woods Run marine limestone.

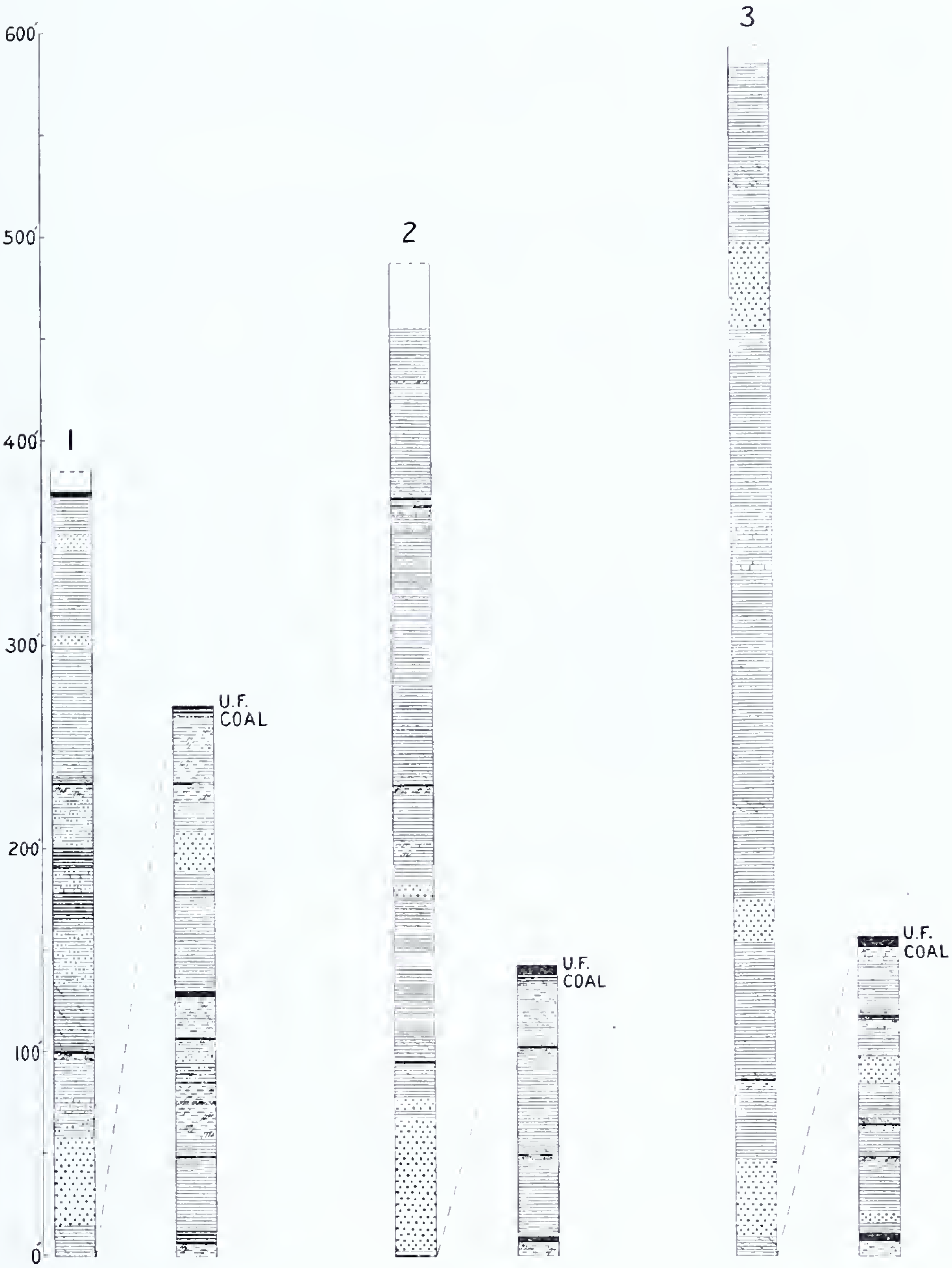

Figure 36. Stratigraphic sections in Fallowfield Township, Washington County, and Rostraver Township, Westmoreland County

1. Diamond drill hole (Ca1), Fallowfield Township, Washington County. Courtesy of H. C. Frick Coke Co.

2. Diamond drill hole (Ca2), Rostraver Township, Westmoreland County. Courtesy of Monessen Coal and Coke Co.

3. Diamond drill hole (Da1), Rostraver Township, Westmoreland County. Courtesy of Monessen Coal and Coke Co.

Monongahela formation. Strata of the Monongahela formation are the surface rocks through the western and northern parts of the area except in the hill tops. In the southeast corner, the strata of this formation crop out only in the stream valleys. The Pittsburgh coal at the formation's base is a persistent and thick coal bed. It is overlain by 50 to 60 feet of dark to drab shales which may locally contain thin sandstone lenses. The Redstone limestone and coal overlie this shale and are persistent beds of good development, well exposed in the bluffs along the Monongahela River. Above the Redstone coal, a series of limestones, the Fishpot, Benwood and Uniontown, exhibit their usual thicknesses and are characteristically interbedded with gray limy shale and clay shale. The Sewickley coal and sandstone were observed between the Fishpot and Benwood limestones, and though believed to be persistent, they are poorly developed. The Arnoldsburg sandstone between the Benwood and Uniontown limestones was found to be a drab thin-bedded to shaly sandstone. Above the Uniontown limestone, both the Uniontown coal and sandstone show as persistent well-developed members. The Waynesburg limestone was not observed in the area and is believed to be either lacking or poorly developed. The Little Waynesburg coal is persistent and has an unusual development in the vicinity of Kenneth (Dc), where it is 4 to 5 feet thick. The coal lies 320± feet above the Pittsburgh coal and is very dirty. It is correlated with the Little Waynesburg rather than the Waynesburg coal because of the short interval, association of black shale, and the lack of an overlying sandstone. The interval between the Little Waynesburg and Waynesburg coals is usually occupied by shale and sandy shale, with sandstone lenses, suggesting a poor development of the Gilboy sandstone. The Waynesburg coal at the top of the formation is persistent through the area and is usually of mineable thickness. The Monongahela formation ranges from 355 to 400 feet thick in Jefferson and Washington townships.

PERMIAN

Washington group. The Washington group is in the hilltops all through the area. Its greatest thickness remaining uneroded is 280 feet in the hills of the southeast corner of Jefferson Township. Little is known concerning the character of this group in the area except that it consists mainly of sandstone and shale, with several relatively thin limestone members. The Waynesburg sandstone at the base is a persistent, drab, coarse-grained, heavy-bedded sandstone that is from 20 to 40 feet thick. The other sandstone members are apparently weak and are not recognizable. Of the limestone members, only the Calvin Run and Woodglen limestones are present as traceable beds. The Waynesburg A and B coals are thin and persistent beds found in outcrops through the area. In the vicinity of Woodglen (Ec) the Washington coal is easily recognizable as a thick dirty coal associated with considerable black shale.

PLEISTOCENE

Carmichaels deposits. Two large areas of Carmichaels deposits in the area occupy abandoned channels of the Monongahela River. One forms the flat (Db) on which Lynwood, Fairhope, and Arnold City are located, and the other forms the valley of the middle courses of Little Redstone Creek and its branch. Small areas of these deposits occur along the Monongahela River, as at Marchandville (Cc), and along Redstone Creek at Grindstone (Ed). These deposits lie 100 to 200 feet above the present drainage level.

Coal resources

The Allegheny formation does not crop out in Jefferson and Washington townships, so the following table of Allegheny coal intervals is based solely on the three diamond drill records Ca1, Ca2, and Da1.

Intervals to the top of the Upper Freeport coal in Jefferson and Washington Townships, in feet

Coal	Average	Range
Brush Creek	95	90 to 100
Upper Freeport	0	0
Lower Freeport	40	37 to 42
Upper Kittanning	93	92 to 94
Lower Kittanning	143	136 to 149
Clarion ?	196	
Brookville ?	264	

The only Conemaugh coal interval given is the Upper Freeport-Brush Creek (locally named Wilson Run coal). The other Conemaugh coals appear to be thin or only locally present.

Monongahela coals are referred by interval to the base of the Pittsburgh coal bed, which is the structure contour horizon in the area and is the base of the formation. Coals of the Washington group are referred to the top of the Waynesburg coal, which represents the group's base.

Monongahela coal intervals to the base of Pittsburgh coal in Jefferson and Washington Townships, in feet

Coal	Average	Range
Waynesburg (top)	360	350 to 380
Little Waynesburg	325	325 to 335
Uniontown	275	255 to 290
Sewickley	145	140 to 150
Redstone	75	60 to 90
Pittsburgh Rider	35	30 to 40
Pittsburgh	0	0

Washington group coal intervals to top of Waynesburg coal in Jefferson and Washington Townships, in feet

Coal	Average	Range
Washington	155	150 to 160
Waynesburg A	65	50 to 80
Waynesburg (top)	0	0

ALLEGHENY COALS

Information on the Allegheny coals is limited to three diamond drill holes (Ca1, Ca2 and Da1) located north and west of Bellevernon. The diamond drill hole (Ca1) ½ mile south of Charleroi, Washington County, penetrates below the Lower Kittanning coal and shows 5 thin coals in the 127 feet of strata penetrated. These coals are from 1 to

10 inches thick. The coals 120 and 53 feet below the Lower Kittanning are tentatively correlated with the Brookville and Clarion coal horizons. The Lower and Upper Kittanning and the Lower and Upper Freeport are found in all three drill holes. The Lower Kittanning and Upper Freeport coals are of mineable thickness, as shown on the following coal sections. The roof of the Lower Kittanning coal is shale and the floor is clay. The Upper Kittanning coal is 2 to 12 inches thick and is represented by 2 feet of black shale in hole Ca1. The Lower Freeport ranges from 12 to 26 inches in thickness and is overlain by shale and underlain by clay. The immediate roof of the Upper Freeport coal is shale, 3 to 15 feet thick, which is overlain by heavy to massive sandstone. It is reasonable to believe that this overlying sandstone may cut down and remove some or all of the coal bed, as is the case to the east, where this coal crops out along Chestnut Ridge.

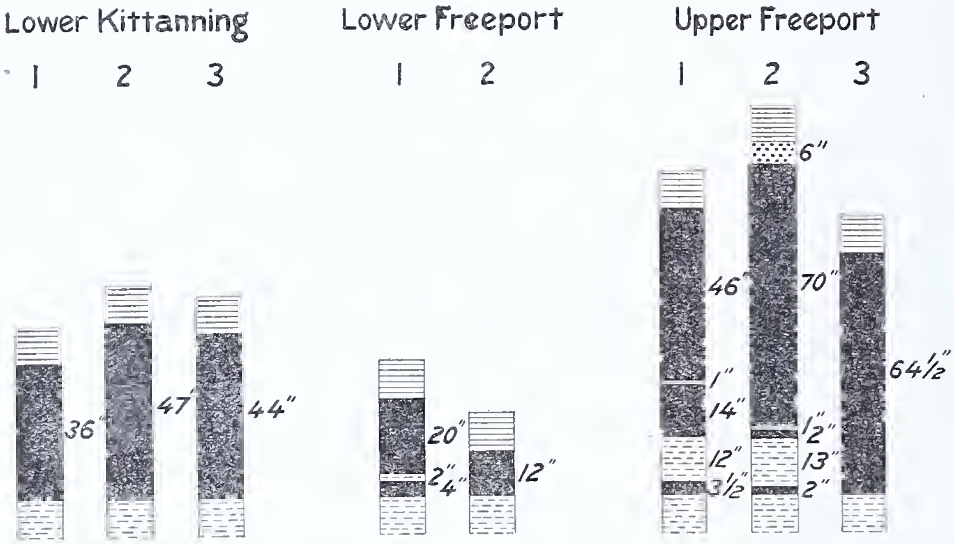

Figure 37. Sections of Allegheny coals near Washington Township.

(Note: Letters and numbers designating locations of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to the tiers of quadrilaterals from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks or prospects, or outcrops).

All below are in diamond drill holes.
Lower Kittanning coal: 1 Ca1. 2. Ca2. 3. Da1.
Lower Freeport coal: 1. Ca2. 2. Da1.
Upper Freeport: 1. Ca1. 2. Ca2. 3. Da1.

CONEMAUGH COALS

The Conemaugh coals are thin and have little value. The Brush Creek coal (local name Wilson Run) is apparently persistent and from 12 to 14 inches thick. The only other persistent Conemaugh coal is the Little Pittsburgh which lies 10 to 20 feet below the Pittsburgh coal and is about 12 inches thick.

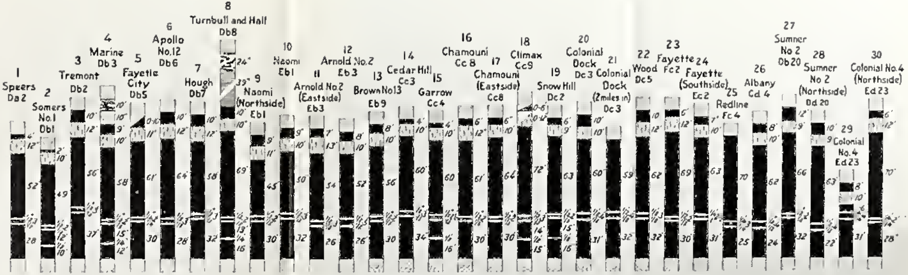

Figure 38. Sections of Pittsburgh coal in Jefferson and Washington Townships

MONONGAHELA COALS

All the Monongahela coals are present in Jefferson and Washington Townships but only the Pittsburgh coal has been mined commercially. Of the other coals, the Redstone, Uniontown, and Waynesburg have been mined for local custom coal.

Pittsburgh coal. The Pittsburgh coal in these townships has been actively exploited along the Monongahela River since about 1850, so that at present active mining is confined chiefly to the southeast part of the area. Only a few mines are active in the north-central and central parts.

The roof of the Pittsburgh coal in Jefferson and Washington Townships is dark to drab shale which contains thin sandstone lenses. The three divisions of the Pittsburgh bed have a combined thickness of 7 to 16 feet, with an average of 10 feet. The roof coal is usually present and generally ranges from 0 to 12 inches in thickness, averaging 8 inches. Unusual thicknesses are found locally in some of the mines of the northwest part of the area where the roof coal may thicken to 5 feet of coal and black shale, as in the Turnbull and Hall mine (Db8), or to nearly 3 feet in the Marine mine (Db3). All through the area the roof coal is bony and mixed with black shale so that it has no value. The main clay parting or ''draw slate'' of the miners is quite persistent, ranging from 8 to 12 inches in thickness. It is reported to be absent locally in some of the mines along the Monongahela River where the roof coal rests directly on the lower division. The lower division of the Pittsburgh bed furnishes the mineable coal and is very regular in occurrence. It varies between 6 and 9 feet thick of clean coal which is divided from top to bottom into breast coal, bearing-in coal, brick coal and lower bottom coal. The lower division is generally 10 to 20 inches thinner along the Monongahela River than in the east part of the townships. The breast coal is from 49 to 70 inches thick and shows only ''knife-blades'' of shale and pyrite in its entire thickness. The bearing-in coal is from 2½ to 6 inches thick. Its associated shale partings at the top and bottom are persistent and are from ¼ to 1 inch thick. The brick coal is sometimes separated from the lower bottom coal by a shale binder ¼ to ½ inch thick. This coal is from 12 to 15 inches thick and can be recognized by its blocky appearance. The lower bottom coal is from 10 to 18 inches thick and is a soft coal containing some thin, irregular shale and pyrite partings near the base. The floor of the Pittsburgh bed in these townships is gray clay which at some localities contains nodules of limestone. Thin clay veins have been reported as cutting across the entire lower division of the Pittsburgh bed but they do not seriously disturb the coal. The so-called ''swamps,'' which are prominent features of the Pittsburgh coal to the north in Westmoreland and Allegheny Counties, are barely noticeable in the north part and are indistinguishable in the south part of these townships.

Pittsburgh Rider coal. This coal is apparently not persistent in Jefferson and Washington Townships as it was observed in only a few localities. It lies 35± feet above the Pittsburgh bed, is less than a foot thick, and is dirty coal.

Redstone coal. The Redstone coal lies 60 to 90 feet above the Pittsburgh coal and is persistent in outcrop. It is known to be mineable north of Little Redstone creek where it is 3½ feet thick. The bed is clean coal with the exception of 4 inches of bony coal near the center. The roof and floor of this coal are gray clay or clay shale. Clay viens cutting across the bed are not uncommon and they disturb the coal to some extent. Along Redstone Creek poor outcrops indicate a 3± foot thickness for this coal so that it may be mineable over most of the townships.

Sewickley coal. This coal is a thin persistent bed lying 145 feet above the Pittsburgh coal. At Redstone the coal crops out in the road (Ee1) and shows 27 inches of weathered coal containing several indeterminable shale partings. At all other outcrops this coal is less than 18 inches thick and appears to be bony or dirty.

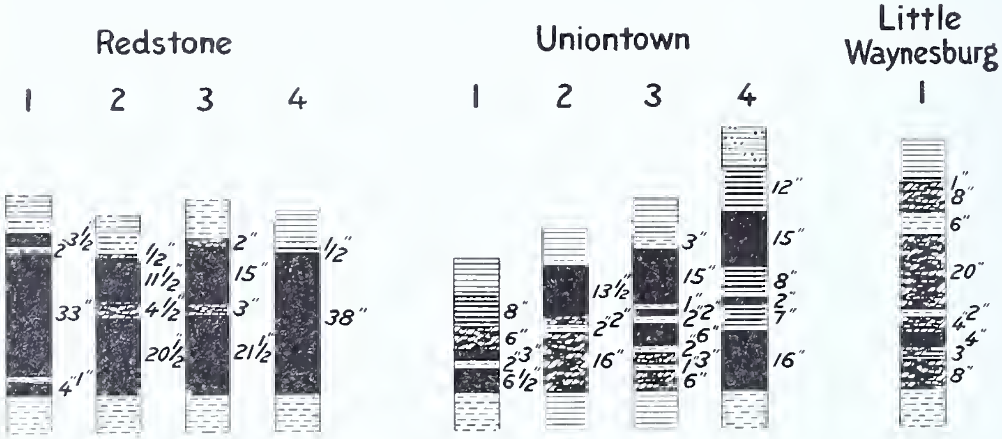

Figure 39. Sections of Redstone, Uniontown, and Little Waynesburg coals in Jefferson and Washington Townships.

Redstone coal: 1. Eb2. 2. Eb8. 3. Eb10. 4. Dc6.
Uniontown coal: 1. Dc14. 2. Dc27. 3. Ec5. 4. Ed22.
Little Waynesburg coal: 1. Dc13.

Uniontown coal. The Uniontown coal lies 255 to 290 feet above the Pittsburgh coal and though attaining thicknesses of 4 feet, as along Redstone Creek (Ed22), the coal has a bony appearance and is broken by several clay partings. A prospect opening (Ec5) on the headwaters of Little Redstone Creek shows the coal 3 feet thick but broken into small benches by four clay partings. The bed is from 2 to 3 feet thick in the southwest part of the area and has the same dirty appearance as elsewhere. In the remaining parts of the area, the coal is less than 18 inches thick and is chiefly bony coal. The immediate roof of the bed is drab shale 4 to 12 feet thick which is overlain by a medium-bedded sandstone.

Little Waynesburg coal. This coal is persistent in the southwest part of the township where it lies 325 to 335 feet above the Pittsburgh coal. In the remainder of the area it was not observed and is believed to be lacking in the section. Abnormal thicknesses of the Little Waynesburg coal were found in the vicinity of Kenneth where a prospect pit (Dc13) exposed 4½ feet of bony coal and bone broken into four benches by clay and black shale partings. A road cut in the same locality (Dc12) exposed 2½± feet of weathered, dirty coal. All other observations show this coal to be less than 1 foot thick and associated with some black shale.

Waynesburg coal. The Waynesburg coal lies 350 to 380 feet above the Pittsburgh coal and forms the top of the Monongahela formation. Its outcrop is found in the hilltops all through Jefferson and Washington Townships. The coal is overlain by 0 to 15 feet of dark and drab shale which in turn is overlain by the usually well-developed Waynesburg sandstone. The Waynesburg coal attains mineable thickness between Redstone and Little Redstone Creek where it is usually a double or triple benched bed from 2 to 6 feet thick containing from one to three partings of clay. Some of these partings locally are 2 feet thick. The coal is generally hard and often contains thin irregular black shale and "sulphur" lens up to ¼ inch thick. Usually the upper bench of the bed is bone or bony coal containing black shale and is valueless. North of Little Redstone Creek, the outcrop of the Waynesburg coal was found in scattered places and where measurable was from 1 to 2 feet thick, consisting usually of dirty or bony coal. The floor of the Waynesburg coal is a dark clay shale to black shale.

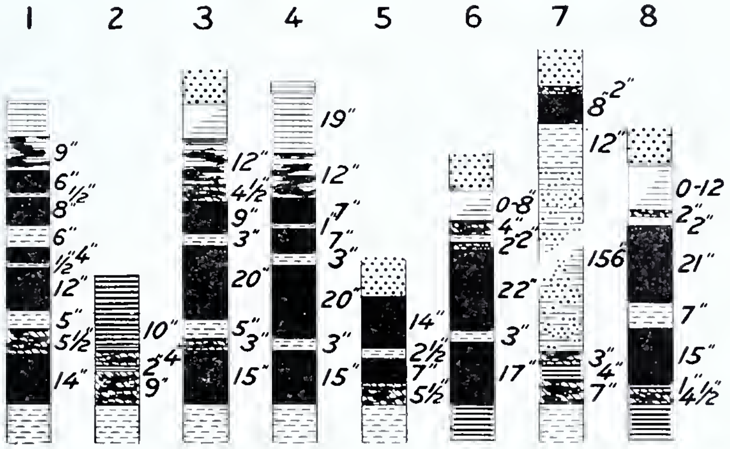

Figure 40. Sections of Waynesburg coal in Jefferson and Washington Townships.

1. Cc7.. 2. Dc11. 3. Dc15. 4. Dc20. 5. Dc23. 6. Ec7. 7. Fc3. 8. Ed15.

WASHINGTON GROUP COALS

Little is known concerning the Washington group coals in Jefferson and Washington Townships. From obtainable exposures only two coals, the Waynesburg A and Washington beds in the lower part of the Washington group, appear to be persistent.

Waynesburg A coal. This coal lies 50 to 80 feet above the top of the Waynesburg coal and was observed in outcrop in the hilltops through the townships. The make-up of the bed varies greatly, and the thickness ranges from 3 to 60 inches. A considerable part of the bed, where it is thick, is occupied by clay and dark shale partings that were observed up to 10 inches thick. On the Connellsville-Fayette City highway an outcrop (Fc2) of the Waynesburg A coal shows two thin benches of coal separated by 14 feet of drab sandy shale and shale. The coal is always dirty with shale streaks and could be classed as bony coal.

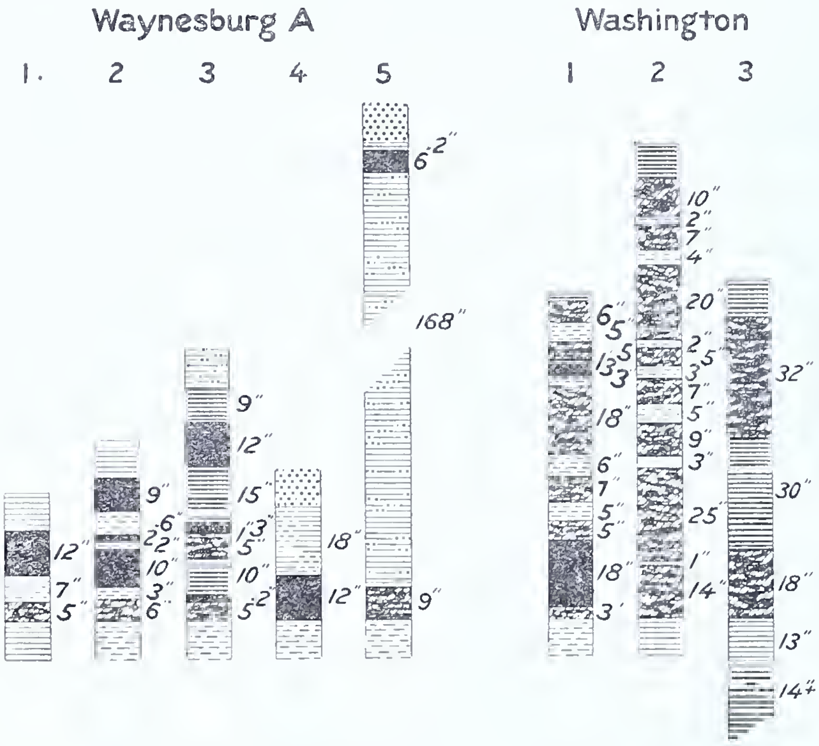

Figure 41. Sections of Waynesburg A and Washington coals in Jefferson and Washington Townships.

Waynesburg coal: 1. Dc22. 2. Dd25. 3. Ed13. 4. Ed16. 5. Fc2.
Washington coal: 1. Fb1. 2. Ed19. 3. Ed20.

Washington coal. The Washington coal is present only in the high hilltops in the southeast part of Jefferson Township and the northeast part of Washington Township. It lies 150 to 160 feet above the Waynesburg coal and is easily identified by the great thickness of the bed. The total thickness is 8 to 10 feet, composed of coal and black shale with at least five clay partings. The coal in the sections examined is very dirty with numerous black shale lens and streaks which are inseparable from the coal. This coal should be classed as bone and bony coal. The Washington coal is persistent and preserves the same characteristics where uneroded in these townships.

Clay and shale

The clay and shale resources of Jefferson and Washington Townships have never been developed. The only refractory clay present in this area would be the main clay parting of the Pittsburgh coal bed, which at other localities than Fayette County, has been used for refractory products. This parting averages 10 inches thick and is persistent through the townships. Numerous shale and clay shale beds are present in the outcropping strata of the Monongahela formation and Washington group which would probably be suitable for building and face brick. No tests were made on any of the clays or shales in these townships.

Limestone

The limestone members of the Monongahela formation and a few limestones of the Washington group are well developed in Jefferson and Washington Townships. The lower member of the Benwood limestone has been opened at several localities, namely: An inactive quarry (Eb6) near Arnold City, an inactive quarry (Dc8) near Kenneth, and an active quarry (Fc3) near Central School. At the last quarry, 12 feet of massive limestone is exposed in the quarry face, from which sample No. F40 was taken. The results of physical tests are given in the Benwood limestone discussion and show the rock to be acceptable for all highway construction. An upright kiln at this quarry converts the product into agricultural lime.

The Colvin Run limestone of the Washington group is quarried (Ed17) for agricultural lime near Woodglen. Here 6 feet of light gray, massive limestone is exposed. Sample No. F43 given in the Colvin Run limestone discussion proves the bed to be acceptable for all highway construction purposes.

An active quarry (Fc5) at Woodglen exposes 8 feet of limestone beds 1 to 2 feet thick, separated by a few inches of clay. This limestone is used for agricultural lime.

Sandstone

The Arnoldsburg (Eb11), Uniontown (Dc9), and Gilboy (Ed12) sandstones of the Monongahela formation and the Waynesburg and Lower Washington (Ed18) sandstones of the Washington group have been worked chiefly for road metal in Jefferson and Washington Townships. At present the only active quarries are on the Waynesburg sandstone which is 20 to 40 feet thick through the area. One mile southwest of Kenneth an active quarry (Dc18) exposes 15± feet of heavy-bedded, coarse-grained buff sandstone, and one mile southeast 15 feet of the same type of sandstone was sampled (sample F39) in an active quarry (Dc24). Along Washwater Run an active quarry exposes 25± feet of light-colored, heavy-bedded, coarse-grained sandstone which was sampled (sample F44). The results of physical tests on these samples are given in the general sandstone chapter. Formerly the Waynesburg sandstone was used as building stone and there is no reason why it cannot still be used for such purpose.

Oil and gas

The Fayette City gas field lies almost entirely in Washington Township. The production is derived from three sands, the Thirty-foot, Gordon and Elizabeth, of which the Elizabeth is more important.

The Kenneth gas field lies in Jefferson Township. Most of the production is obtained from the Elizabeth sand although some gas has been found in the Big Injun and Thirty-foot sands.

These two fields are discussed in the general oil and gas chapter.

FRANKLIN, PERRY, LOWER TYRONE, AND UPPER TYRONE TOWNSHIPS

Introduction

Franklin, Perry, Lower Tyrone, and Upper Tyrone townships are discussed as a unit because they lie across the Fayette anticline from the axis of Lambert syncline to near the axis of the Uniontown syncline. Also they include nearly all the outcrop of the Allegheny and Pottsville formations in the gorges of the Youghiogheny River and Jacobs Creek through the Fayette anticline. These townships are along the central part of the north boundary of the county, with Franklin Township, extending south as far as Redstone Creek.

The Youghiogheny River has a crooked northwest course between Lower Tyrone and Franklin townships and through Perry Township. It and small tributaries drain the northern part of Franklin, nearly all of Perry and the southern parts of Lower Tyrone and Upper Tyrone townships. The southern part of Franklin Township is drained by Redstone Creek, which likewise pursues a northwest course along the southwest boundary. Jacobs Creek has a winding course along the north boundary of the county and drains northeastern Perry, and northern Lower and Upper Tyrone townships. This creek has very short tributaries. It joins the Youghiogheny River at the point where the river leaves Fayette County.

The main streams that drain the area flow for the greater part through narrow steep-sided valleys; those of the Youghiogheny River and Jacobs Creek are aptly termed gorges. However, Jacobs Creek flows through a wide, swampy valley with gentle side slopes from the northeast corner of Upper Tyrone Township (Kb) to Tyrone Mills (Ib) where it enters the gorge that continues to its mouth. The valley of Redstone Creek above Upper Middletown Station widens considerably and the side slopes lose much of their abruptness. The Youghiogheny River flows in a crooked deeply entrenched valley through the area. Galley Run, a tributary of the river, rises near Summit Mines (Jc), at which point a low divide of only about 30 feet separates it from the level of Jacobs Creek. At some time in the future, erosion will have removed this low valley divide and the waters of Jacobs Creek will be diverted and flow through the valley of Galley Run to join the Youghiogheny River at Broad Ford.

The topography of the area is rugged and consists of knobby hills that rise to a general altitude of 1,200 to 1,350 feet, in all except northern Franklin, southeastern Perry and central Lower Tyrone townships where the hills are flat-topped and rise to altitudes of 1,400 to 1,560 feet. This area of flat-topped hills lies along the Fayette anticline and the hills are formed by the erosion-resisting, massive sandstones of the middle Conemaugh formation.

The industries located in these townships are varied. Farming is important in most of the area. Industries utilizing the mineral resources are the manufacturing of clay building and refractory brick, silica brick, natural gas development and the mining of coal and glass sand. Railroads serving the townships are the Pennsylvania, which has branch lines along Redstone Creek; the Baltimore & Ohio which has a trunk line along the north bank of the Youghiogheny River and branch lines along Galley and Hickman Runs; the Pittsburgh & Lake Erie which has a trunk line along the south bank of the Youghiogheny River with branch lines along Dickerson and Washington Runs; and the Pittsburgh & Wheeling which has a trunk line along the south bank of Jacobs Creek.

Structure

The four townships, Franklin, Perry, Lower and Upper Tyrone, comprise an area of which the underlying rock structure is a complete cross-section of the Fayette anticline, extending from the Lambert synclinal axis on the west to the Uniontown synclinal axis on the east. The axis of the Lambert syncline enters Perry Township from the south near Quaker Church (Fc) and follows a northerly course to Mill Run (Fb) where its position becomes indeterminable. At this point the Lambert syncline is absorbed in the more pronounced structure of the Port Royal syncline. The east limb of the latter syncline forms the underlying structure of the extreme northwest corner of Perry Township. From the axis of the Lambert syncline the strata rise steeply eastward up the flank of the Fayette anticline at a maximum rate of 400 feet per mile. The anticlinal axis has a northeast course through central Franklin Township, crossing the Youghiogheny River at the mouth of Virgin Run (Gc) and continuing through western Lower Tyrone Township. In its course through these townships the axis steadily rises 550 feet to the north county line and forms a narrow sloping crest. The strata on the east flank of the Fayette anticline slope less steeply than those of the west flank and have a maximum rate of slope of 300 feet per mile. In Upper Tyrone Township the slope of the strata decreases as the axis of the Uniontown syncline is approached. A very minor sub-trough or syncline of the main Uniontown basin causes this decrease as well as the change in strike direction of the strata. The Uniontown synclinal axis cuts across the northeast corner of Upper Tyrone Township in the wide, relatively flat bottom of the syncline.

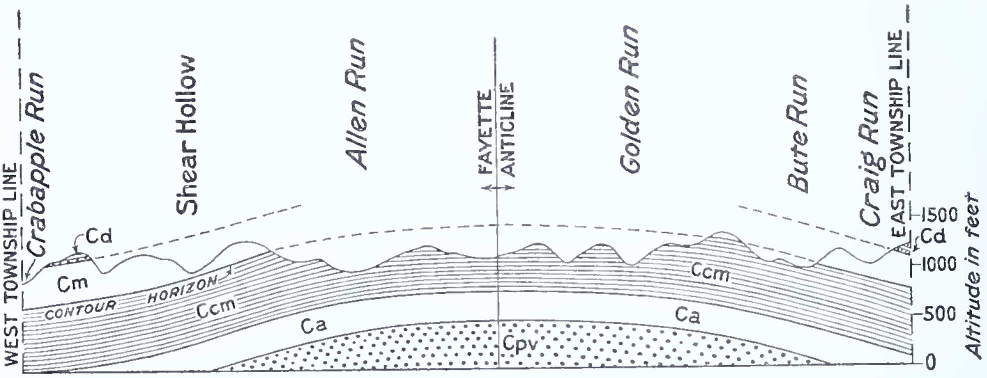

Figure 42. Structure section across Franklin Township.

Legend: Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation

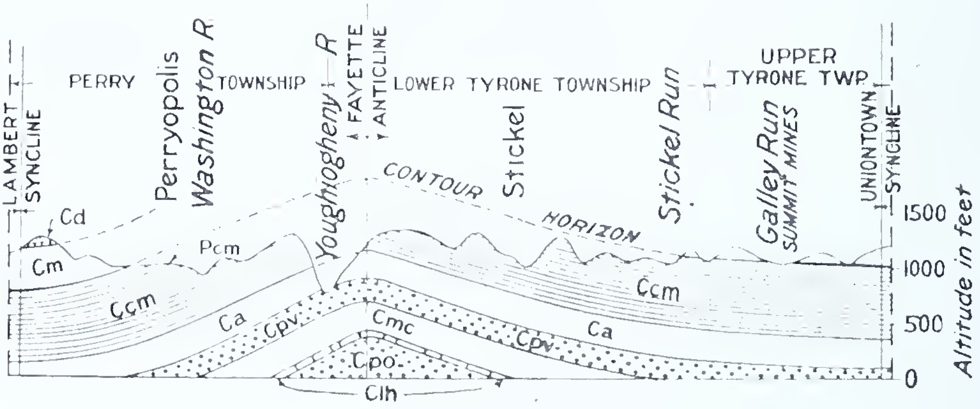

Figure 43. Structure section across Perry Township.

Legend: Pcm—Carmichaels deposits; Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono formation.

Stratigraphy

The age of the consolidated strata that crop out in Franklin, Perry, Lower Tyrone, and Upper Tyrone townships ranges from upper Pottsville time through Allegheny, Conemaugh and Monongahela to lower Permian time. The exposed strata comprise a total section of about 1,650 feet. Unconsolidated sediments are found along the course of the Youghiogheny River. Carmichaels deposits cover two large areas, one in the vicinity of Perryopolis (Fb) and the other near Dawson (Ic). Alluvial deposits of Recent age are found on the flood plains of the major streams draining the area.

PENNSYLVANIAN

Pottsville formation. The top of the Pottsville formation is exposed in two small areas (Gb, Gg), where the Youghiogheny River crosses the Fayette anticline. In these areas the top 50 to 75 feet of the Homewood sandstone member crops out above water level and consists of heavy-bedded to massive, light gray, coarse-grained sandstone. Some of the beds are conglomeratic. In the area (Gb) just southeast of Layton, quarries were and are being operated on this sandstone to obtain material for the manufacture of refractory silica brick.

The Homewood sandstone member is also exposed (Hb) in the valley of Jacobs Creek where the stream crosses the Fayette anticline. Here the sandstone is heavy-bedded to massive, is coarse-grained and has a light gray color. An excellent exposure may be seen at the waterfalls on the east flank of the anticline.

The Mercer horizon probably is above water level both along the Youghiogheny River and Jacobs Creek but it is concealed by float rock and could not be observed.

Allegheny formation. The Allegheny formation is in continuous outcrop on the sides of the gorge of Youghiogheny River from Layton (Gb) to Laurel Run (He) and also in the gorge of Jacobs Creek from Chaintown (Ib) downstream to within 2 miles of the mouth. Along Jacobs Creek excellent exposures yield a complete section of the formation, which here measures 220 feet thick. Below the Brookville coal there are 12 to 15 feet of dark to drab shale. The Brookville and Clarion coals, neither of which is thick enough to be commercially important, are separated by 20 feet of clay shale and clay. In the Jacobs Creek section, the Kittanning sandstone is a prominent massive coarse-grained bed. The Lower Kittanning coal is a very persistent bed throughout the area. It is usually overlain by 10 to 20 feet of dark to drab laminated shale, although along the Youghiogheny River east of Virgin Run the Westernport sandstone directly overlies or is close above the coal over large areas. The Westernport member is well developed throughout the area as a light gray, coarse-grained sandstone. In the eastern section this member unites with the Freeport sandstone and occupies the entire interval between the Lower Kittanning and Lower Freeport coals, as shown in the Bessemer drill hole section. The Middle Kittanning coal is an intermittent bed in the western part of the area, but appears to be lacking in the eastern part. The Upper Kittanning coal is generally persistent along the Fayette anticline, but disappears to the east, where it is cut out by the Westernport sandstone. Above the Upper Kittanning coal the Freeport sandstone is locally present as a thin-bedded member. The Lower Freeport coal, a persistent bed, usually lies close above a thin freshwater limestone bed. Between the Lower and Upper Freeport coals the Butler sandstone is persistent. It is thin to medium-bedded and medium-grained. The Bolivar flint clay is an important member on the west flank of the Fayette anticline, where it was formerly mined along with the Upper Freeport plastic clay. The Upper Freeport limestone was observed in several localities on the Fayette anticline. Although it appears to be fairly persistent, it is usually thin. The Upper Freeport coal is a persistent, easily recognized bed. It is overlain by the Mahoning sandstone, which locally cuts down and displaces the coal.

As shown in the measured section on Jacobs Creek and the drill hole sections in this area, the Allegheny formation rapidly resumes its normal thickness westward from its abnormally thin section exposed on the west flank of the Chestnut Ridge anticline in Bullskin Township. Likewise, the westward decline in prominence of the arenaceous sediments, especially in the interval between the Lower Kittanning and Lower Freeport coals, is clearly illustrated by the stratigraphic sections and exposures in the area.

Conemaugh formation. The Conemaugh formation crops out in a wide belt on the Fayette anticline that extends north and south through the central part of the area under discussion. The surface strata in nearly all of Lower Tyrone, the central half of Franklin and the eastern two-thirds of Perry Township belong to this group. The formation in the area is from 650 to 685 feet thick. It is composed chiefly of shale and clay shale in the upper two-thirds, but is dominantly arenaceous in the lower third. The Mahoning member at the base is prominent as a medium- to heavy-bedded coarse-grained sandstone of light color. The lower division locally cuts down into and through the underlying Upper Freeport coal. In the middle division the Mahoning clay and associated shale are usually present. The Mahoning coal and limestone were not found in outcrop, but are reported to be present in some localities. Above the Mahoning group the Brush Creek coal and black shale are persistent beds. The Buffalo sandstone, which is generally prominent, contains an appreciable thickness of the Meyersdale red and green shale. Between the Buffalo and Saltsburg sandstones are the persistent Lower Bakerstown and Bakerstown coals. The overlying Saltsburg sandstone is well developed throughout the area, forming cliffs and prominent hilltops and underlying extensive sandy flats on the Fayette anticline. It is a medium-bedded to massive, coarse-grained, light-colored sandstone that locally has some conglomeratic layers. It also contains some minor drab shale lenses. Red, green, and drab shales occur between the Saltsburg and Morgantown sandstones. In these shales the Ewing limestone, Harlem coal, and Barton coal are persistent beds. The Morgantown and Connellsville sandstones are both prominent in their areas of outcrop. Locally they may change rapidly to sandy shale. The Clarksburg coal and limestone lying between these two sandstones were observed in several localities as thin unimportant beds. The Pittsburgh limestone, above the Connellsville sandstone, is believed to be a persistent bed. Exposures show it to be a thin, ferruginous, fresh-water limestone.

Monongahela formation. The Monongahela formation crops out well up on both flanks of the Fayette anticline in the Uniontown basin and the Klondike district. It forms the surface strata in nearly all of Upper Tyrone Township, the southeast and western parts of Franklin Township, and the west third of Perry Township. In Lower Tyrone Township it is exposed in only a few hilltops in the extreme eastern section. The thickness of the formation on the west limb of the Fayette anticline is between 370 and 390 feet, but on the east limb it is only 335 to 360 feet. The Pittsburgh coal at the base of the formation is very regular and persistent. It is 10 to 15 feet thick and generally separated from the overlying Pittsburgh sandstone by a dark shale. In the Lambert syncline in western parts of Franklin and Perry townships, the Pittsburgh sandstone is well developed and persistent and occupies most of the interval up to the Redstone limestone. In the Uniontown syncline (eastern Franklin and Upper Tyrone townships) the interval between the Pittsburgh coal and Redstone limestone is occupied chiefly by dark shale in which occur thin beds and scattered lenses of Pittsburgh sandstone. The Redstone limestone is a persistent bed in both the Lambert and Uniontown synclines, averaging about 7 feet thick. The Redstone coal, also a persistent bed, lies close above the Redstone limestone. Between the Redstone and Sewickley coals, the interval is occupied mainly by shale and sandy shale with sandstone lenses. Near the middle of this interval, the Fishpot limestone is present, 10 to 25 foot thick, and composed of interbedded limestone and shale. The Sewickley coal is present throughout its area of outcrop. It is overlain by a series of limestone beds containing much interbedded shale and some thin sandstone beds. This series of strata comprises the Benwood limestone member which extends upward to near the Uniontown coal. In the Benwood limestone, about 55 feet above the Sewickley coal, an irregularly occurring thin coal and black shale bed is tentatively correlated with the Benwood or Bench coal of the Greensburg area. The Arnoldsburg sandstone lying above the Benwood limestone is of irregular occurrence so that the overlying Uniontown limestone is often inseparable from the Benwood limestone. The Uniontown coal is thin and sporadic in occurrence. Above it, the interval to the Waynesburg coal is occupied by the Uniontown sandstone, Waynesburg limestone and Gilboy sandstone, all of which have local occurrence and contain much shale. In the Uniontown basin this interval is shorter than in the Lambert syncline because of the apparent absence of the Gilboy sandstone. The Waynesburg coal which marks the top of the Monongahela formation is persistent through its outcrop in the area, although very locally it may be cut out by the overlying Waynesburg sandstone. In the Uniontown basin, this coal is present only in the southeast part of Franklin Township.

PERMIAN

Washington group. The lower part of the Washington group represents the only Permian strata remaining uneroded in the townships under discussion. In the Lambert syncline it caps the hills in western Perry and the extreme west corner of Franklin Township. The greatest thickness uneroded in the Lambert syncline is about 300 feet near Wickhaven (Fb). In the Uniontown basin the strata of the Washington group are found only in the extreme southeast corner of Franklin Township where the greatest thickness remaining in any hilltop is less than 150 feet. At the base of the group the Cassville shale is generally present. It is a drab to dark shale that directly overlies the Waynesburg coal. The overlying Waynesburg sandstone is a thick persistent bed. It is light gray to buff, coarse-grained, and medium-bedded to massive. The top, and at some localities, the entire member tends to be slabby as a result of cross-bedding. Little is known concerning the strata of the Washington group above the Waynesburg sandstone. From scattered exposures, shale and sandy shale appear to dominate, with some limestone and sandstone beds. The coals are thin and occur irregularly as lenses.

PLEISTOCENE

Carmichaels deposits. The unconsolidated river deposits known as Carmichaels deposits occur on the elevated flats in the vicinity of Perryopolis and Dawson. They represent deposits in abandoned channels and terraces of the Youghiogheny River. In the Perryopolis area (Fb, Gb, Gc), the top consists of 15± feet of white clay, which is underlain by 20± feet of coarse sand. Many boulders and pebbles are scattered through the deposits. In the past the top clay was utilized for the manufacture of bricks and the sand for the manufacture of glass. Nothing is known of the character of the deposits in the Dawson area (Hc, Ic). From surface indications, this area contains more gravel and boulders than the Perryopolis area.

RECENT

Alluvium. Unconsolidated sands and gravels of Recent age occur in the present flood plains of the Youghiogheny River. The largest areas of these deposits are near Dickerson Run (Hc), Layton (Gb), and near the mouth of Jacobs Creek (Fb, Gb). They appear to consist chiefly of sand and gravel with minor amounts of sandy clay.

Coal resources

The following tables show the intervals from the principal coals of each formation to the main coal of the particular formation in the area under discussion. As coals of Pottsville and Permian times are thin and unimportant, there are no interval tables for these formations.

Allegheny coal intervals to top of Upper Freeport coal in Franklin, Perry, Lower Tyrone, and Upper Tyrone Townships, in feet

Coal	Average	Range
Upper Freeport	0	0
Lower Freeport	50	35–75
Upper Kittanning	100	90–110
Middle Kittanning	135	120–145
Lower Kittanning	170	155–180
Brookville-Clarion	235	220–250

Conemaugh coal intervals above top of Upper Freeport coal

Coal	Average	Range
Barton	385	360–410
Bakerstown	245	230–280
Lower Bakerstown	195	185–210
Brush Creek	125	115–140
Upper Freeport	0	0

Monongahela intervals to base of Pittsburgh coal

Coal	Average	Range
Waynesburg (top)		
Perry & western Franklin townships	380	370–395
Upper Tyrone and eastern Franklin townships	350	335–360
Uniontown	280	270–290
Benwood	180	170–190
Sewickley	125	110–135
Redstone	80	60– 95
Pittsburgh	0	0

ALLEGHENY COALS

In these townships, the Allegheny coals are above drainage only in the gorge of Jacobs Creek west of Chaintown (Ib) and in the gorge of Youghiogheny River between Layton (Gb) and Laurel Run (Hc). Elsewhere in the area coals of this age lie under heavy cover.

BROOKVILLE-CLARION COALS

The Brookville and Clarion coals were observed only along Jacobs Creek near the crest of the Fayette anticline, where they are separate beds. In this exposure along the railroad tracks, the Brookville coal is from 3 to 17 inches thick and the Clarion coal from 0 to 15 inches. They are separated by 10 to 25 feet of dark to brown shale.

Lower Kittanning.—The Lower Kittanning coal is persistent throughout the area, lying 155 to 180 feet below the Upper Freeport bed. It is reported in scattered drill holes and was observed at many places along its outcrop. The bed ranges between 24 and 40 inches in thickness and is generally composed of clean, bright coal of medium hardness. In the north and to the west, near Layton, a clay parting up to 2 inches thick is found locally near the base of the bed. The floor of the coal is fire clay from 2 to 6 feet thick. The roof is usually dark shale, although east of Virgin Run on the Youghiogheny River the overlying Westernport sandstone rests directly on the coal over large areas. In the past, the Lower Kittanning coal was mined commercially at Corrado Nos. 1 and 2 mines (Gc2, Hc9). The coal in these mines was from 30 to 40 inches thick and has a sandstone roof to which the coal adheres. From surface studies, the coal of these mines would correlate with the Lower Kittanning horizon. It is reported that diamond drill holes in the vicinity penetrated a persistent coal bed 36 inches thick that lay about 100 feet below the mined bed. A coal bed that crops out 35 feet above the entrance to Corrado No. 2 mine was said to be lacking in the drill holes of which records were not available. As correlated, the higher coal would be the Middle Kittanning bed and the lower coal would represent the Brookville-Clarion horizon.

Middle Kittanning coal. The Middle Kittanning coal, lying 25 to 45 feet above the Lower Kittanning bed, is generally present in the western part of the area. In the eastern part, the coal evidently has a sporadic occurrence because the Westernport sandstone has a

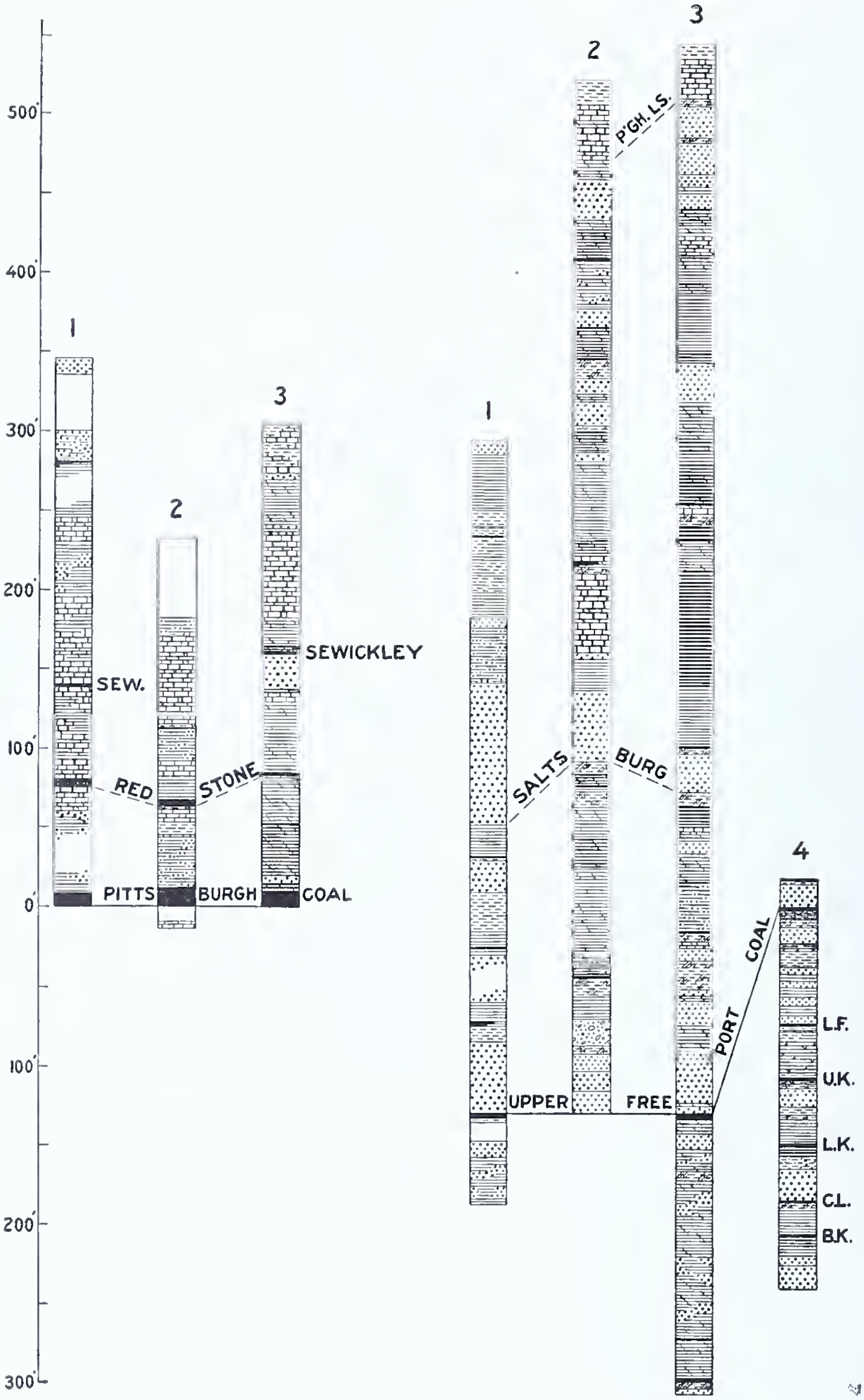

Figure 44. Stratigraphic sections in or near Perry Township.

Monongahela formation. 1. Measured section in creek gully at Whitsett (Fb), Perry Township; 2. Section along Brownellers Run (Fb), Perry Township, as measured by J. J. Stevenson: Pennsylvania 2d Geol. Survey, Report KK, p. 204. 3. Standard shaft No. 2 (La1), Mount Pleasant Township, Westmoreland County: H. C. Frick Coke Co.

Conemaugh and Allegheny formations. 1. Section along Youghiogheny River west of Dawson (Ic): Pennsylvania 2d Geol. Survey, Report KK, p. 200. 2. Jimtown bore-hole (Ic4), H. C. Frick Coke Co.; 3. Bessemer bore-hole (Ka1), East Huntingdon Township, Westmoreland County, H. C. Frick Coke Co.; 4. Section along Jacobs Creek (Gb, Hb) on west flank of Fayette anticline.

stronger development to the east and tends to replace the coal. The Middle Kittanning coal, where present, is thin and not important. Along the Youghiogheny River it has local thicknesses up to 30 inches and consists of rather bony coal frequently split by partings. It has a sandstone roof and a clay or black shale floor.

Upper Kittanning coal. The Upper Kittanning coal lies 90 to 110 feet below the top of the Upper Freeport coal. It appears to have a local occurrence. The best development was observed in the Jacobs Creek gorge (Hb) and in the vicinity of Layton (Gb), in which localities the coal is from 22 to 32 inches thick. The top 1 to 4 inches is bone coal, but the remainder of the bed consists of clean coal. The roof is either shale or sandstone and the floor is clay.

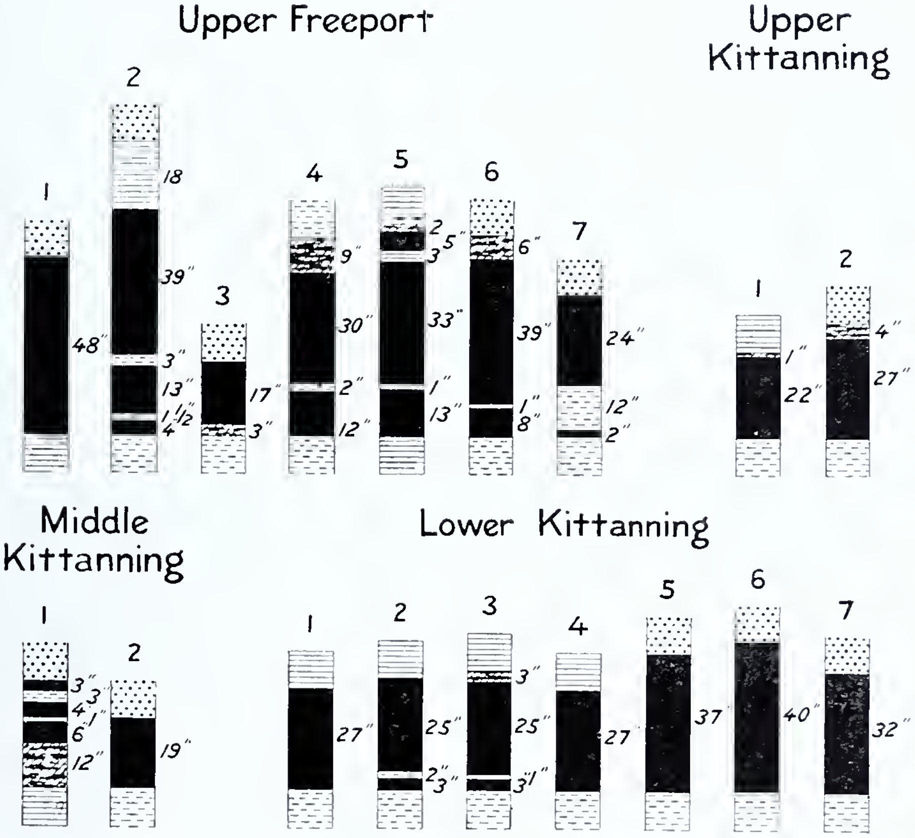

Figure 45. Sections of Allegheny coals in Franklin, Perry, and Tyrone Townships.

(Note: Letters and numbers designating locations of sections refer to the 2½ minute quadrilaterals, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers of quadrilaterals from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks, prospects or outcrops).

Upper Freeport coal: 1. Ka1; Bessemer drill hole. 2. Hb4; Florence mine. 3. Gb1; 4. Gb2; 5. Gb8, Bowers mine. 6. Ge3, Ruth mine. 7. Hc5.

Upper Kittanning coal: 1. Hb1; 2. Gb7.

Middle Kittanning coal: 1. Gb12; 2. Gc2.

Lower Kittanning coal: 1. Ka1; Bessemer drill-hole; 2. Hb2; 3. Gb9. 4. Gb11; 5. Gc2, Corrado No. 1 mine. 6. Gc2, Corrado No. 1 mine; 7. Hc9, Corrado No. 2 mine.

Lower Freeport coal. The Lower Freeport coal is a thin persistent bed occurring 35 to 75 feet below the Upper Freeport coal. The great variance in interval appears to be dependent on the development of the Butler sandstone which lies between the two beds. Where observed, the Lower Freeport coal is less than 15 inches thick.

Upper Freeport coal. The Upper Freeport coal is a thick, persistent, mineable bed throughout its area of outcrop and drill-hole records indicate that these qualities persist where the coal lies at depth. Local exceptions occur where the overlying Mahoning sandstone cuts down and replaces part or all of the coal. Clay veins up to 18 inches thick were observed in several localities and, according to reports, are encountered at very infrequent intervals. The Upper Freeport coal in these townships is generally a double-benched bed ranging from 46 to 60 inches in thickness. The bottom bench is from 2 to 18 inches thick and locally may contain a thin shale parting near the base. Sulphur (pyrite) balls and streaks occur sparingly in this bench. The upper bench, separated from the lower by 1 to 12 inches of clay, is generally about 40 inches thick. It consists of clean coal in all except the top 1 to 10 inches which contain much interbedded shale and must be classed as a bone or bony coal. The usual roof of the coal is a light gray clay shale from 0 to 4 feet thick. It is overlain by the Mahoning sandstone that may locally replace the shale and rest directly on the coal. In such instances the coal tends to cling or be ''burned'' to the sandstone. The usual floor of the coal is plastic gray clay. At present the Upper Freeport coal is mined only for house coal but in the past several extensive mines worked the bed. The largest of these, the Florence mine (Hb4), was located on Jacobs Creek. At the time of operation, coal was hauled three miles overland by tram to the railroads on the Youghiogheny River.

CONEMAUGH COALS

The Conemaugh coals crop out in central Franklin, eastern Perry and Lower Tyrone townships. Although there are many coal beds in this formation, most of them are too thin in this area to have any value. Only the Brush Creek, Lower Bakerstown, Bakerstown and Barton beds were observed to have mineable thicknesses. Of these, the Brush Creek coal, lying 115 to 140 feet above the Upper Freeport coal, just approaches mineable proportions as its usual thickness is between 8 and 12 inches.

Lower Bakerstown coal. The Lower Bakerstown bed, lying 185 to 210 feet above the Upper Freeport coal, is persistent throughout its area of outcrop. Locally it attains mineable thickness. The bed consists of a single bench of clean coal from 10 to 33 inches thick which is often overlain by 2 to 4 inches of bone. The roof is clay shale or shale and the floor is plastic clay.

Bakerstown coal. The Bakerstown coal in the area lies 230 to 280 feet above the base of the formation. This interval and the interval of the Lower Bakerstown coal are larger than elsewhere in the county. It is believed, provided the correlations are correct, that the good developments of the Buffalo, and Upper and Lower Mahoning sandstones in this particular section are responsible for the increase in these intervals. Definite correlations of the coals near the middle of the formation are difficult because of the apparent absence of the Ames limestone. The deciding factor in correlating the Bakerstown coal in this area was the presence of 40 or more feet of heavy-bedded, coarse-grained sandstone occurring either directly on or close above the coal bed.

The Bakerstown bed is persistent. It ranges from 20 to 36 inches of clean, bright coal. Locally thin partings of clay or shale may occur near the top of the bed. The immediate roof is drab shale in all except the southern part of Franklin Township where the overlying Saltsburg sandstone rests directly on the coal. At present, this bed is worked only for custom coal but in the past it is reported to have been worked commercially near Waltersburg (Fe12). It is also reported that some of the production of the mine was made into satisfactory coke in standard beehive ovens.

Barton coal. The Barton coal, which appears to be persistent, lies 385 feet above the Upper Freeport coal. It is from 15 to 40 inches thick and consists of dirty coal with numerous partings of clay and shale. Some custom coal is obtained from this bed.

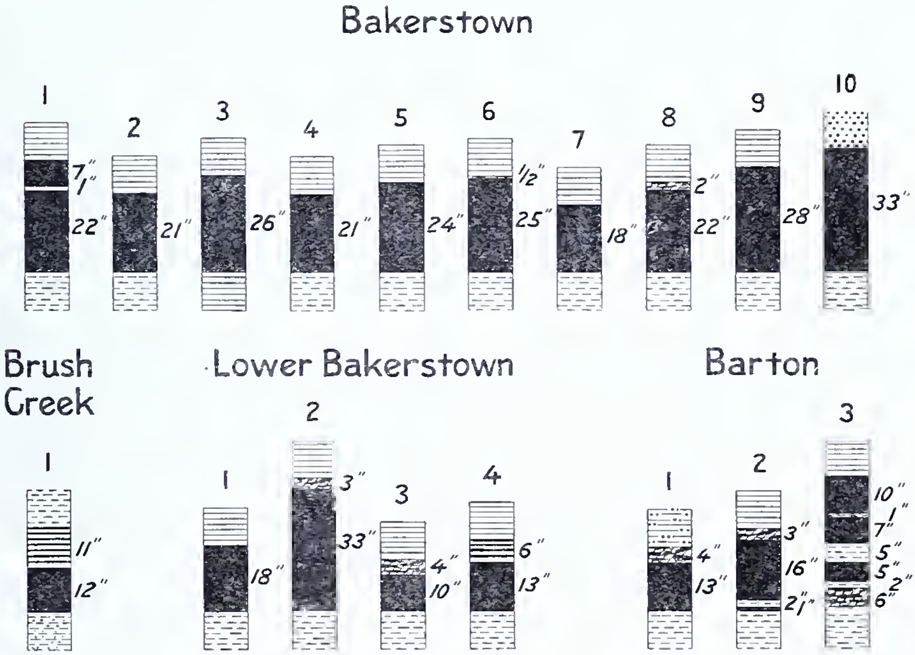

Figure 46. Sections of Conemaugh coals in Franklin, Perry, and Tyrone Townships.

Bakerstown coal: 1. Hb3; 2. Hb5; 3. Gb4; 4. Hc2; 5. Hc7; 6. Hc8; 7. Hd1; 8. Gd1; 9. Fd6; 10. Fe12.

Brush Creek coal: 1. Hc6.

Lower Bakerstown coal: 1. Ib1; 2. Gb6; 3. Hc4; 4. Gd2.

Barton coal: 1. Ic3; 2. Hc3; 3. Fd5.

MONONGAHELA COALS

Coals of the Monongahela formation crop out in Upper Tyrone and eastern Franklin townships in the Uniontown basin and in the western parts of Perry and Franklin townships in the Klondike or River district. Commercial development of the Pittsburgh coal in Upper Tyrone Township began in the early days of mining in Fayette County. The other Monongahela coals have been developed only for custom coal as they are generally too thin and irregular for commercial mining.

Pittsburgh coal. In the past, the Pittsburgh coal was intensively mined throughout the area of its occurrence. Many of the first commercial mines in Fayette County were in this bed in Upper Tyrone ship, also, the coal has been mined for a long time. Consequently, there is little Pittsburgh coal left unmined in the area and the small quantity available consists of pillars and outcrop coal remaining in the mines.

The total thickness of the three divisions of the Pittsburgh bed ranges from 9 to 14 feet in the area. It has, universally, a dark to drab shale roof. The roof coal or top division is persistent and from 1 to 5 feet thick, the greatest thicknesses occurring in the Uniontown basin. Where thickest it consists of dirty coal containing much interbedded shale, and appears to be valueless. The main clay parting or middle division "draw slate" is also persistent throughout the area. It is from 9 to 24 inches thick, averaging about 12 inches. The lower or main division of the Pittsburgh bed is from 7 to 9 feet thick, with an average thickness in the Uniontown syncline slightly greater than that in the Klondike district. The breast coal or upper bench consists of clean coal from 48 to 68 inches thick. Very locally a thin shale parting up to ½ inch thick occurs slightly below the middle of this bench. The bearing-in bench, from 3 to 6 inches thick, is usually present. It consists of 2 to 5 inches of coal with shale partings at the top and bottom. These shale partings are each from ¼ to ¾ inch thick. They are the only persistent binders or partings present in the entire lower division. Underneath the bearing-in-coal, the remainder of the bed has the same appearance and characteristics and cannot be subdivided into the usual brick and lower bottom benches. Hence this section of the bed will be termed the bottom bench. It is from 27 to 36 inches thick and contains clean coal. The coal of the entire lower division of the Pittsburgh bed in this area, especially in the Uniontown basin, is remarkably clean and regular in occurrence. The floor of the coal is a plastic light gray clay that rolls up at infrequent intervals in Perry and western Franklin townships and displaces the lower portion of the coal.

Redstone coal. The Redstone coal lies 60 to 95 feet above the base of the Pittsburgh bed. It is the thickest in the Klondike district in Perry Township, where it attains a maximum of 73 inches. With this unusual thickness, the upper 30 inches of the bed is dirty and contains considerable bone coal. The normal thickness of the Redstone coal in Perry Township is between 3 and 4 feet. It consists of fairly clean, hard coal, of which the top 2 to 6 inches is bone coal. "Sulphur" lenses and balls have a scattered occurrence through the bed. In the Uniontown basin in Upper Tyrone and eastern Franklin townships, the Redstone coal has an average thickness of about 16 inches. In this section the coal is dirty with numerous knife edges of slate and may contain much bony coal. The roof of the bed is gray shale or clay shale and the floor is generally clay, although locally it may be limestone.

Sewickley coal. The Sewickley coal is persistent and lies about 125 feet above the base of the formation. Its average thickness is greater in the Klondike district than in the Uniontown basin. In Perry and western Franklin townships it is 20 to 48 inches thick and in Upper Tyrone and eastern Franklin townships its thickness is less than 22 inches. The bed commonly has a 1- to 4-inch layer of bone coal at the top, a 2- to 9-inch bench of bone and shale near the center, and 1 to 5 inches of bony coal at the base. The roof of the bed is shale or clay shale and the floor is plastic clay.

Benwood coal. The Benwood coal has a sporadic occurrence in the Uniontown basin and appears to be lacking in the Klondike district. In its lens-shaped occurrence it was observed to attain a maximum thickness of 30 inches and to consist of dirty coal. This bed is usually represented in the stratigraphic section by a black, blocky shale which replaces the coal.

Uniontown coal. The Uniontown coal has a very irregular occurrence. It was observed along Crabapple Run (Ed24) in Franklin Township to be 50 inches thick; nearly half of the thickness consists of shale and clay partings. Where observed at other localities, the bed was less than 18 inches thick and was composed of dirty coal.

Waynesburg coal. The Waynesburg bed lies about 350 feet above the Pittsburgh coal in the Uniontown basin and about 380 feet in the Klondike district. It has a limited area of occurrence in the western part of Perry Township and in the extreme eastern and western parts of Franklin Township. Elsewhere in the area it has been removed by erosion. In the Uniontown basin the bed is worked near Butte (He5), where it is 24 inches thick. Here it is a double-benched bed containing fairly hard coal. The shale parting separating the two benches occurs just below the center of the bed and is 1 to 3 inches thick. A thin layer of bone coal is present at the top of each bench. Streaks and balls of sulphur (pyrite) are scattered through the bed. The Cassville shale is about 10 feet thick at these workings and is overlain by the heavy-bedded Waynesburg sandstone. In the Klondike district, the Waynesburg coal is persistent, but is thinner than in the Uniontown basin. Observations in Perry Township show it to be a single-bench bed from 10 to 20 inches thick. Here the coal appears to be moderately dirty with knife edges of shale. The Waynesburg sandstone usually lies a short interval above the coal, but locally may rest directly on the coal.

PERMIAN COALS

The Permian coals have a very limited occurrence in western Perry and in eastern and western Franklin townships. From observation, they appear to be thin and irregular in occurrence and to contain considerable interbedded shale.

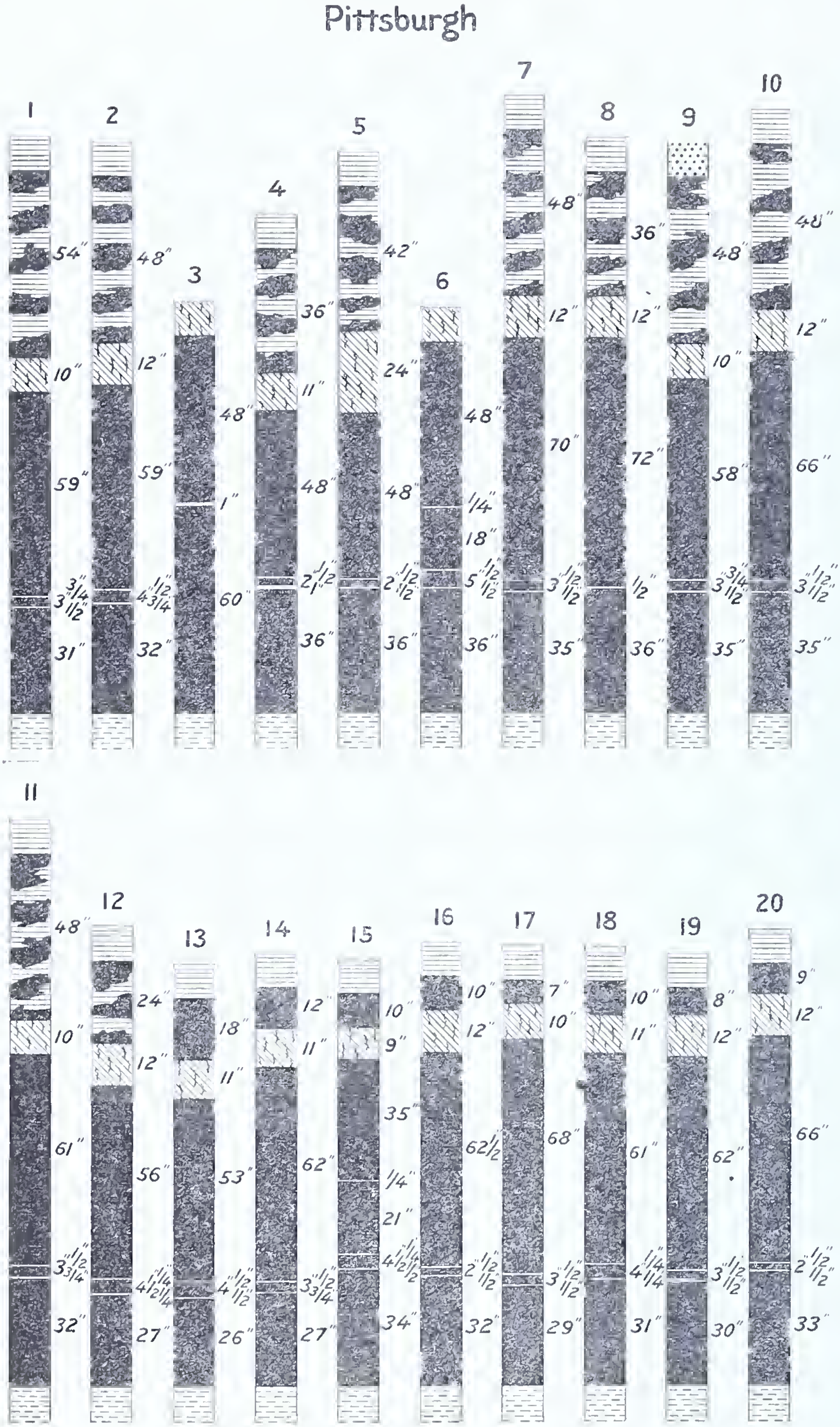

Figure 47. Sections of Pittsburgh coal in Franklin, Perry, and Tyrone Townships.

1. Kb6, Dexter No. 2 mine; 2 Jc3, Franklin mine; 3. Jc5, Valley mine; 4. Jc13, Morgan mine; 5. Ic7, Spring Grove mine; 6. Id1, Jackson mine; 7. Hd2, Butte No. 2 mine; 8. Hd5, Butte No. 4 mine; 9. He3, Elm Grove mine; 10. Ge1, Bittner No. 1 mine; 11. Ge3, Work mine; 12. Ga1. Banning No. 1 mine; 13. Fb2, Wineland mine; 14. Fb8, Banning No. 2 mine; 15. Fb9, Jamieson No. 22 mine; 16. Fc7, Washington No. 2 mine; 17. Fc9, Washington No. 1 mine; 18. Fc11, Jamieson No. 21 mine; 19. Fd2, Leon Mine; 20. Fd4, Colonial No. 1 mine.

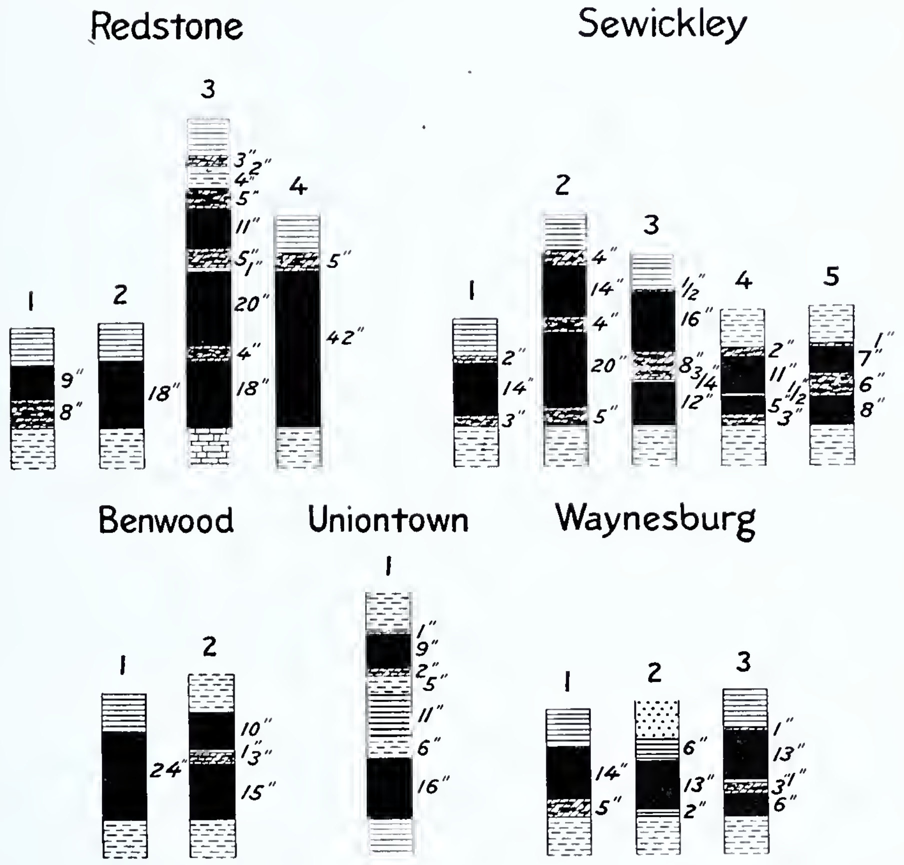

Figure 48. Sections of Monongahela coals in Franklin, Perry, and Tyrone Townships.

Redstone coal: 1. Kb4; 2. Kc8; 3. Fb4; 4. Fb10.
Sewickley coal: 1. Jc9; 2. Fb3; 3. Fb5; 4. Fd3; 5. He1.
Benwood coal: 1. Jc10; 2. He4.
Uniontown coal: He4.
Waynesburg coal: 1. Fb6; 2. Fb7; 3. He5.

Clay and shale

The only active brick plant in the county is about half a mile east of Perryopolis (Gb). A blue-gray shale bed, that lies directly above the Brush Creek limestone, is quarried for part of the raw mix. This shale, which is 15 feet thick, is overlain by a variable thickness of sandstone that is in turn overlain by 15 feet of Carmichaels clay. The raw mix consists of Carmichaels clay and the blue-gray shale, and after burning yields red building and rough scratch brick of good quality. More detailed information on this operation is given in the general clay and shale chapter. An analysis of the clay underlying the Brush Creek limestone near the quarry is also listed.

About ¾ mile west of Layton, two clay beds 40 to 50 feet apart have been extensively worked in the recent past to furnish raw material for fire and paving brick. The upper bed is 8 feet thick and consists of plastic light-gray clay and clay shale. This bed correlates with the Middle Mahoning clay. The lower bed is semi-flint clay and is 8 feet thick. Heavy-bedded sandstone overlies the clay at the entrance and a short distance into the mine, but reports state that in the mine the clay is overlain by a good thickness of coal which was mined with the clay for fuel. Thus this lower clay bed is believed to be the Bolivar clay, as the conditions here agree closely with those encountered in the various mines on the Upper Freeport coal in the near vicinity where the overlying Mahoning sandstone locally replaces the coal and some of the immediately underlying beds. However, Mr. Leighton in his general discussion correlates this clay with the Middle Mahoning horizon. Analyses of the two beds are given in the clay chapter.

Along the Youghiogheny River between Layton (Gb) and Dickerson Run (Hc) there are several abandoned openings on the Bolivar and Lower Kittanning clays. No data are available on the quantity and quality of the clay in these openings.

There are unlimited quantities of shale in the townships under discussion that would probably be suitable for the manufacture of building brick. The fire clays of the Allegheny and Lower Conemaugh formations are easily accessible in their outcrops in the gorges of Jacobs Creek and Youghiogheny River and near the crest of the Fayette anticline.

Limestone

Limestone beds of Allegheny, Conemaugh, Monongahela and Permian age are exposed in various sections of these four townships. The Upper and Lower Freeport limestones near the top of the Allegheny formation were observed along Jacobs Creek and Youghiogheny River. They are thin and usually consist of a layer of limestone nodules. Several thin impure beds of limestone near the middle of the Conemaugh formation crop out through Lower Tyrone and central Franklin townships. The Allegheny and Conemaugh limestones are suitable only for agricultural purposes. The Monongahela limestones crop out in the east and west portions of the area, being described where they have been exploited for agricultural lime and road-metal. They contribute the principal source of limestone in the area. Of these beds, the Benwood limestone has been worked most extensively. The Redstone and Fishpot limestones have been worked to a lesser degree. The Permian limestones occur only locally in the area and have undergone little development.

Detailed information and analyses of the Monongahela limestones are given in the general chapter on limestone in this report.

Sandstone

The sandstone beds in Franklin, Perry, Lower Tyrone and Upper Tyrone townships have been developed for various uses. Large quarries and an underground mine along the Youghiogheny River half a mile southeast of Layton (Gb) are working the massive, coarse-grained Homewood sandstone for manufacture into silica brick. It is reported that the sandstone from these quarries has been used at times for glass manufacture. In the Conemaugh formation the Mahoning, Buffalo, Saltsburg, Morgantown, and Connellsville sandstones have been quarried for road metal, building, coke-oven masonry, and for concrete. The Saltsburg and Morgantown beds are said to have been quarried for glass and sand before 1900. In the Monongahela formation the Pittsburgh, Sewickley, Benwood, and Uniontown sandstones were worked for road metal. Locally, as in eastern Franklin Township, the Pittsburgh sandstone is suitable for coke-oven masonry. The Waynesburg sandstone in western Perry Township has been quarried for building stone and road metal. Generally, the sandstone beds of the Monongahela and Permian formations are not as heavy-bedded, nor as pure, durable or dense as the Conemaugh and Pottsville beds. For more detailed information and analyses of the sandstone beds of this area, the reader is referred to the general chapter on sandstone.

Oil and gas

The axis of the Fayette anticline passes through the central part of the area and, although it is rising fairly rapidly to the north, it represents moderately favorable ground for gas prospecting. The winding course of the axis and the indications of steps on the northward rise of the axis suggest the probability of small structural terraces both along the crest and on the flanks of the anticline. There is also a suggestion of a structural high on the axis just before it leaves the county. The inherent characteristic of the oil and gas sands of western Pennsylvania to occur as lenses also suggests the possibility of obtaining gas production on the wide flanks of the Fayette anticline where the upper end of the inclined lenses would act as a collecting reservoir. So far as is known, this section of the Fayette anticline has not been adequately tested. A well one mile east of Perryopolis and down the west flank of the anticline produced gas for several years. The Waltersburg field has produced gas since 1910 from successively deeper sands which were exploited as the upper sands were depleted. A well on the east flank of the Fayette anticline near Dawson yielded moderate production for several years. The general chapter on oil and gas gives more detailed information on drilling and gas production in this area.

Sand and gravel

Sand and gravel are available along the Youghiogheny River in the present flood plains of Recent age and in the Carmichaels deposits that occur near Perryopolis and Dawson. The Carmichaels sand near Perryopolis is reported to have been used for glass sand in the past. At present there are no sand or gravel operations in the area.

BROWNSVILLE AND REDSTONE TOWNSHIPS

Introduction

Brownsville and Redstone townships are described together because of the small size of Brownsville Township and the similarity of their outcropping strata. They lie in the western part of the county, fronting on the Monongahela River and extending 7 miles southeastward and away from the river between Redstone and Dunlap Creeks. Their approximate center is in map quadrilateral De. Brownsville Borough is included in this discussion.

The area is drained by Redstone and Dunlap Creeks, both of which pursue intrenched meandering northwest courses to the Monongahela River. The secondary drainage consists of Colvin and Rowe Runs; tributaries to Redstone Creek; and Fourmile, Lilly and Saltlick Runs; tributaries to Dunlap Creek. From the narrow valley of Redstone Creek, the slopes rise steeply 300 to 400 feet to a general level of flat-topped hills at 1,200 to 1,300 feet elevation, which persist through the area. Below or north of Merrittstown (Ce), the valley of Dunlap Creek is narrow and has steep sides, but south of Merrittstown, the valley becomes considerably wider and the sides have less abrupt slopes.

Coal mining and bee hive coke manufacture are the principle industries of the area. The coal mines are served by a branch and spurs of the Pennsylvania Railroad along Redstone Creek, a branch and spurs of the Monongahela Railroad along Dunlap Creek, and a line of the Pittsburgh & Lake Erie Railroad along the Monongahela River.

Structure

Brownsville Borough and Township lie on the Brownsville anticline, the axis of which passes through the center of the township with a southwestward plunge. Redstone Township lies chiefly in the Lambert syncline with the Brownsville anticlinal axis cutting across the extreme western corner of the township. The deepest part of the Lambert syncline, in Fayette County, lies in the south-central part (De) of this township where the Pittsburgh coal has an elevation of 400 feet. In the area under discussion, only moderate folding of the strata is encountered; the greatest dip is on the east limb of the Lambert syncline in the eastern part of Redstone Township. Here the strata rise eastward at a maximum rate of 320 feet to the mile. The Lambert synclinal axis is 400 feet lower structurally than the Brownsville anticlinal axis and the beds on the connecting flank have a maximum westward rise of 180 feet per mile. These structural axes trend approximately N30°E across the township and lie about 3 miles apart.

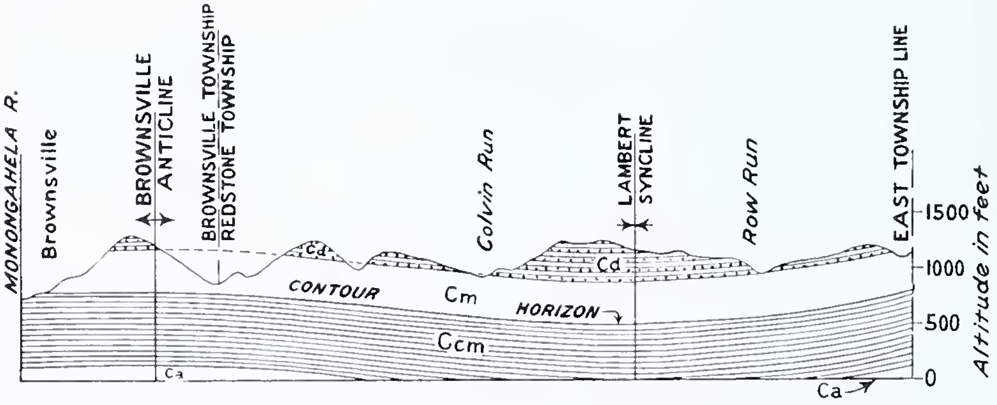

Figure 49. Structure section across Brownsville and Redstone Townships.

Legend: Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation.

The base of the Pittsburgh coal bed is the structure contour level and the contour interval is 20 feet.

Stratigraphy

The outcropping consolidated strata of Brownsville and Redstone townships range from Upper Conemaugh of Pennsylvania time to Greene Group of Permian time. These exposed rocks comprise a stratigraphic section of approximately 900 feet. Unconsolidated sediments are represented by a few small remnants of Carmichaels deposits of Pleistocene age and alluvium of Recent age.

PENNSYLVANIAN

Conemaugh formation. Upper Conemaugh strata are exposed in the valley of Redstone Creek at Smock (Fe), where they go under drainage to the west and do not appear downstream until near Linn (Dd). From Linn the outcrop is continuous to the mouth of Redstone Creek, south along the Monongahela River and up the valley of Dunlap Creek to the southwest corner (Cd) of Brownsville Township. Little is known of the Conemaugh rocks outcropping in these townships, as the maximum thickness above drainage is only 40 feet at Smock and is very poorly exposed. The exposures in the northwest area are also poor and are mostly concealed by the flood-plain deposits.

Monongahela formation. Beginning at Smock (Fe), strata of the Monongahela formation are exposed continuously down Redstone Creek to the mouth, along the Monongahela River and up Dunlap Creek to Republic (Ce), where the Waynesburg coal goes under drainage. The upper members of this formation are also exposed along the headwaters of Row Run in the eastern part (Ee) of Redstone Township. In the area under discussion, the Monongahela formation varies from 370 to 400 feet thick and is composed of non-marine limestones, shale and clay shale. The Pittsburgh coal bed at the base is very persistent and regular. It is usually overlain by 50 to 70 feet of black to gray shales and clay shales which contain the Pittsburgh Rider coal, and local sandstone beds comprising the Pittsburgh sandstone. Above these shales lie 55 to 90 feet of limestone, shale and fire clay (probably gray clay shales) to the persistent Sewickley coal bed. The Redstone coal and limestone have a very local occurrence near the bottom of this interval, the Fishpot limestone 15 to 35 feet thick is persistent in the middle, and black to gray shales, with local sandstones, occupy the upper 25 feet of the interval. Between the Sewickley and Uniontown coals, the Benwood limestone 80 to 120 feet thick is well developed and the overlying Arnoldsburg sandstone is usually present up to 25 feet thick, although in some places replaced by shale. The Uniontown limestone is of sporadic nature, but where present varies between 3 and 10 feet thick. From the Uniontown coal or black shale to the Waynesburg coal, the interval is chiefly shale and sandstone with the exception of the Waynesburg limestone 5 to 25 feet thick occurring in the lower half of this interval. The top of the formation, as used in this report, is the top of the Waynesburg coal bed, which is persistent and generally mineable in Brownsville and Redstone town-

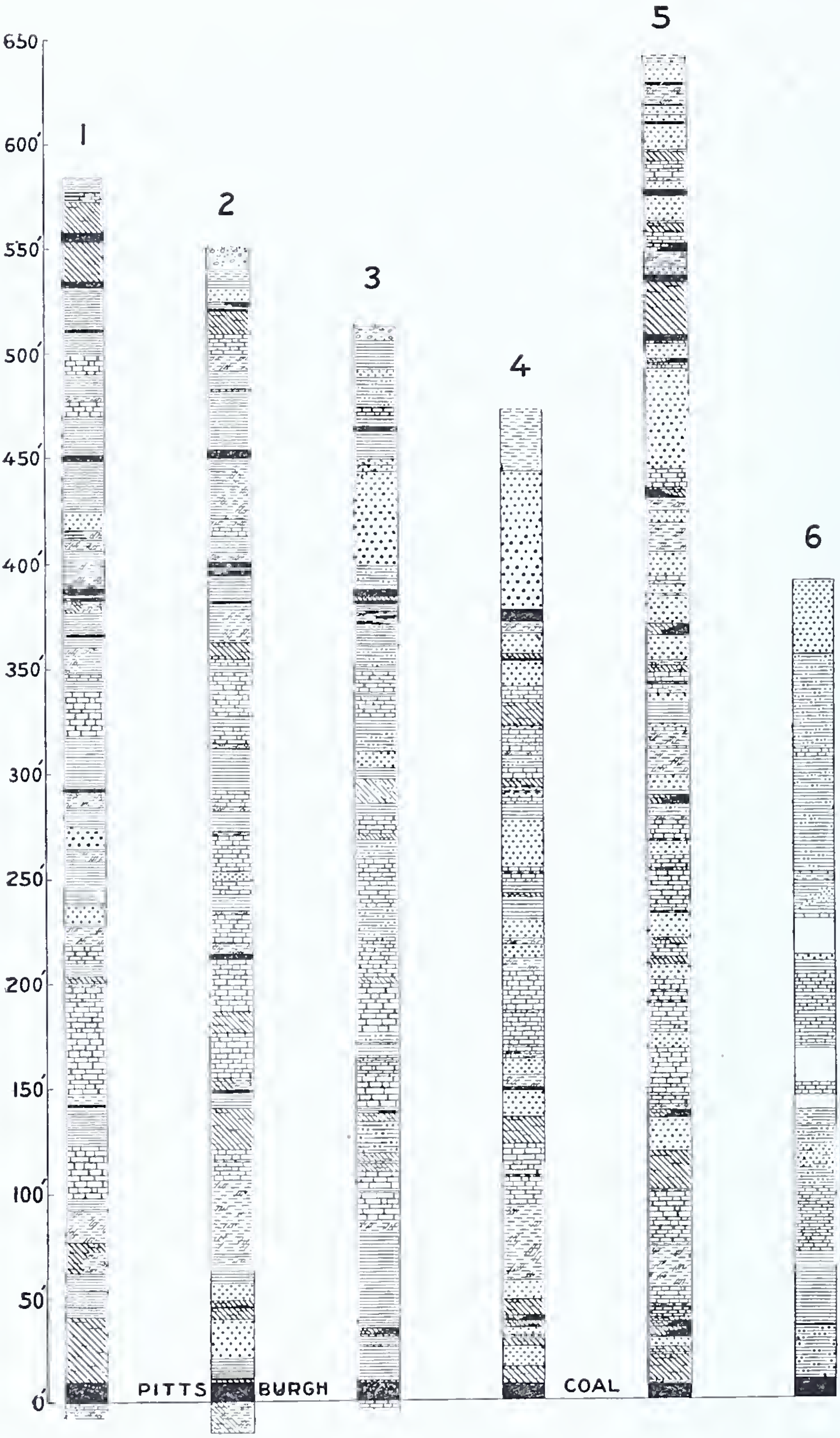

Figure 50. Stratigraphic sections in Brownsville and Redstone Townships.

1. Filbert air shaft; H. C. Frick Coke Co. (Df6).
2. Filbert hoisting shaft; H. C. Frick Coke Co. (Df5).
3. Orient diamond drill hole; Orient Coke Co. (Df4).
4. Republic shaft No. 1; Republic Iron and Steel Co. (Ce7).
5. Brier Hill shaft No. 1; Brier Hill Coke Co. (Ee6).
6. Section from National Pike, near east line of Brownsville Township, down hill to Dunlap Creek (Cd), as measured by J. J. Stevenson; Pennsylvania 2d Geol. Survey, Report KK, p. 233.

ships. Excellent sections of the Monongahela formation in the two townships are shown in the plotted mine shaft sections given later in the discussion. Some of these shaft sections are described in detail under the general stratigraphy of the Monongahela formation.

PERMIAN

Washington group. The boundaries of the Washington group are the top of the Waynesburg coal and the top of the Upper Washington limestone, including, in Brownsville and Redstone townships, a stratigraphic interval of approximately 400 feet. The rocks of this group form the surface of most of Redstone Township and crop out in the high hilltops of Brownsville Township. Mine-shaft sections give detailed information on the lower half of the group, which consists chiefly of sandstone and shale, with thin limestone beds and numerous coal beds, many of which are lenticular. The upper half of the group has the same characteristics, as judged from the outcrops along the National Pike and other scattered localities. Important and easily recognized members are the Waynesburg sandstone, Washington coal, Brier Hill sandstone, and the Upper Washington limestone. These members are all fairly persistent and they exhibit the general characteristics given in the general discussion of this group's stratigraphy.

Greene group. The strata of the Greene group represent the youngest consolidated rocks of Brownsville and Redstone townships. They crop out in these townships as isolated patches in the high hilltops along the Lambert synclinal axis from Brier Hill (De) to the southwest township corner (Cf). Because of poor outcrops, little is known concerning the stratigraphy of the group except that they appear to be series of shales and sandstones. Not more than the basal 75 feet of the Greene group is preserved in any hilltop.

PLEISTOCENE

Carmichaels deposits. A few small remnants of Carmichaels deposits were observed 100 to 120 feet above Redstone Creek, west of Row Run, and at Brownsville 160 to 190 feet above the Monongahela River. These patches show sand and rounded sandstone fragments on the surface and are believed not to exceed 15 feet in thickness.

Coal resources

In the following tables, no intervals are given for Conemaugh and Allegheny coals as they lie at depths in Brownsville and Redstone townships and no direct information on them is obtainable. Gas wells show the Pittsburgh-Upper Freeport interval to be approximately 630 feet.

Monongahela coal intervals to base of Pittsburgh coal in Brownsville and Redstone townships, in feet

Coal	Average	Range
Waynesburg (top)	380	370 to 405
Uniontown	290	275 to 310
Sewickley	140	130 to 150
Redstone (horizon)	75	60 to 80
Pittsburgh Rider	35	30 to 45
Pittsburgh	0	0

Permian coal intervals to top of Waynesburg coal in Brownsville and Redstone townships, in feet

Coal	Average	Range
Washington A		245
Washington	165	160 to 170
Little Washington	140	135 to 140
Waynesburg B	120	115 to 125
Waynesburg A	65	50 to 80
Waynesburg	0	0

The short interval range of the Permian coals is caused by the small number of observation points obtainable on these relatively unimportant coals.

ALLEGHENY COALS

The Allegheny coals have from 600 to 1,500 feet of cover in Brownsville and Redstone townships and, though deeply buried, may constitute an important coal reserve. No direct information is obtainable on these coals in the townships, but the diamond drill-hole record given in the Luzerne Township discussion shows the probable character of the beds of the Allegheny formation underlying these townships.

CONEMAUGH COALS

No information is available on the Conemaugh coals in Brownsville and Redstone townships. However, from the general character of these coals observed elsewhere in Fayette County, they are probably of little importance.

MONONGAHELA COALS

The Monongahela formation contains the important commercial coals in Brownsville and Redstone townships. The Pittsburgh coal is mined extensively and the Waynesburg has been mined commercially in the past.

Pittsburgh coal. The Pittsburgh coal bed lies at the base of the Monongahela formation and is, by far, the most important coal in the townships. This coal has been actively mined since the 1870's in Brownsville and Redstone townships and a large portion of the coal has already been removed.

The normal roof of the Pittsburgh coal in the area is dark gray to black shale, except in Brownsville Township and the northwest corner of Redstone Township, where the roof is shale with sandstone lens or sandy shale, or thin-bedded sandstone. Over the remainder of the area, sandstone may very locally form the roof of the coal. The Pittsburgh coal ranges from 8½ feet to 13½ feet in thickness and is a double bed consisting of the roof coal or division, the main clay parting or overclay, and the lower or main division. These three divisions are present in all the area except the central and southwest sections. Here the roof coal is generally absent and the main clay parting is locally absent. The roof coal attains its greatest thickness in the northeast corner of Redstone Township, where it ranges from 12 inches in the eastern part of the Royal mine (Fe3) to 48 inches thick in the Grace mine (Fd1). In Brownsville Township and the remaining parts of Redstone Township, this coal ranges from 2 to 10 inches thick. At no place in the area can the roof coal be considered of value, as it is very

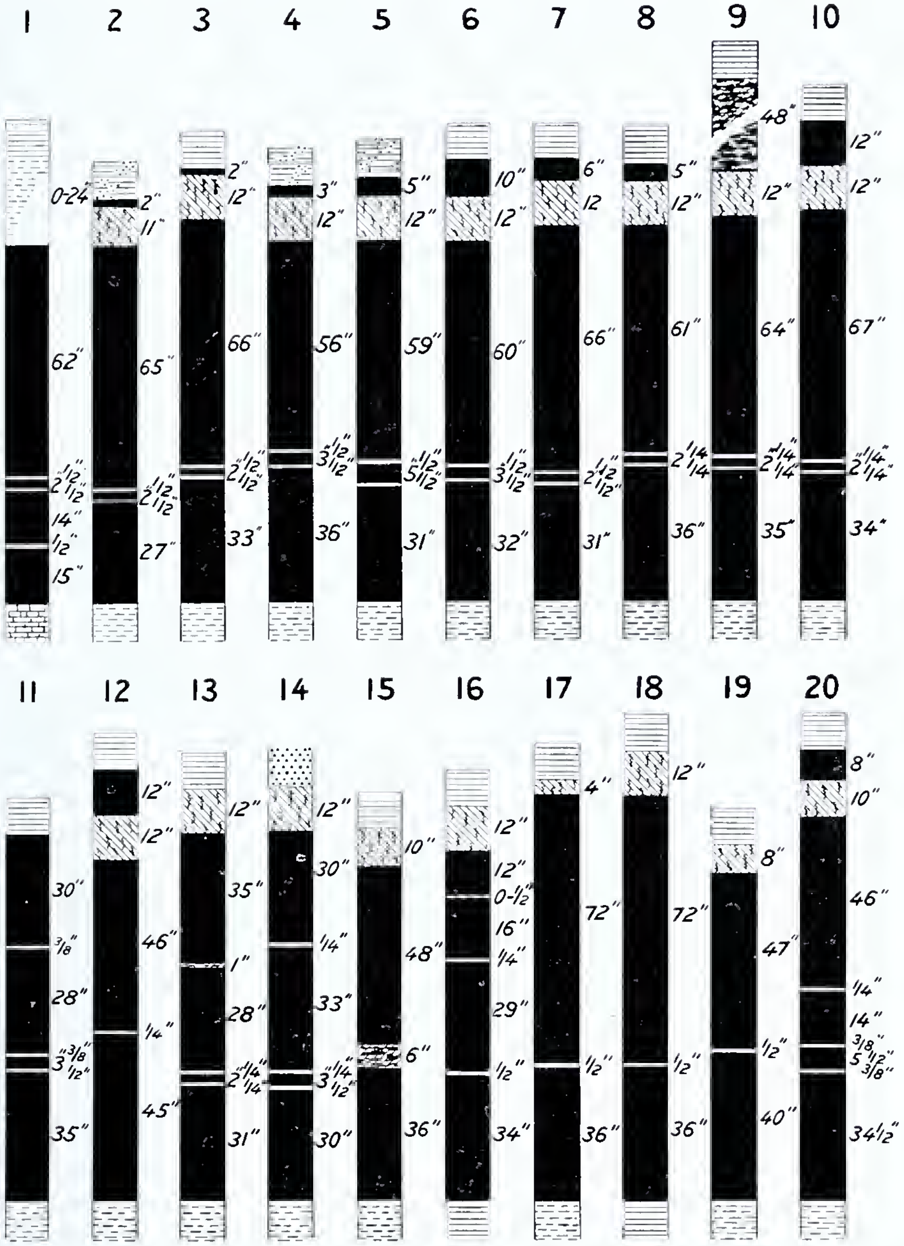

Figure 51. Sections of Pittsburgh coal in Brownsville and Redstone Townships.

(Note:—Letters and numbers designating location of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers of quadrilaterals from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks, prospects or outcrops.)

1. Cd1, Umpire mine. 2. Cd2, Pike mine. 3. Cd3, Century mine. 4. Dd3, American No. 1 mine. 5. Dd2, Mt. Hope mine. 6. Dd1, American No. 2 mine. 7. Ed2, Colonial No. 3 mine. 8. Ed2, Colonial No. 3 mine. 9. Fd1, Grace mine. 10. Ee3, Royal mine (east side). 11, Ee3, Royal mine (west side). 12. Ee6, Brier Hill mine. 13. De3, Allison No. 1 mine. 14. De3, Allison No. 1 mine. 15. Ce4, Garwood mine. 16. Ce7, Republic mine. 17. Cf1, Tower Hill No. 1 mine. 18. Df4, Orient mine. 19. Df5, Filbert mine. 20. Ef4, Herbert mine.

dirty, and where it attains good thickness it is intimately interbedded with black shale. The main clay parting or overclay is generally present and is 2 to 24 inches thick, averaging 11 inches. It is the draw slate of this region. The main or lower division is from 7¼ feet to 9½ feet thick and is clean coal with the exception of some thin shale or bone partings. Generally, it may be stated that this division is thicker in the eastern half of the area than in the western half. The breast coal of the lower division is 4 to 6 feet thick and is usually free of binders or partings. Locally, thin shale partings up to ⅜ inch or bone partings up to 1 inch thick appear at a level about 30 inches below the top of the coal. The top 6 to 10 inches of the breast coal in the western and northwestern parts of the area often have "sulphur" and bone streaks which are not separable in mining. In some mines where the roof is bad, the sulphurous top, 6 to 12 inches, is left in place as roof support. The bearing-in coal is from 2½ to 6½ inches thick and is generally recognizable through these townships. The shale partings at the top and bottom of this coal are from a film to ½ inch thick. Locally, either or both of the partings may be absent from this section. An unusual occurrence is in the Garwood mine (Ce4), where the bearing-in coal is reported to consist of 6 inches of bone. The blocky nature of the brick coal directly underneath the bearing-in coal is not persistent in Brownsville and Redstone townships. Consequently the remainder of the lower division underneath the bearing-in coal will be discussed as one subdivision, called the bottom coal, which will include both the brick and lower bottom coal. The bottom coal forms the base of the Pittsburgh coal bed and is 27 to 40 inches thick. The top 10 to 15 inches of this bench often has a blocky nature which the basal portion does not exhibit. In the northern part of Brownsville Township a shale parting occurs locally about 15 inches above the base of the bed. Otherwise the bottom coal is free of partings. The basal 4 to 6 inches of coal carries "sulphur" and bone streaks, and in some mines this portion is left in place. The normal floor of the Pittsburgh coal is soft gray clay or clay shale, but locally limestone may directly underlie the coal, as reported in the Orient (Cf4) and Umpire (Cd1) mines.

Pittsburgh rider coal. The Pittsburgh rider coal lies 30 to 45 feet above the base of the Pittsburgh coal. It is a dirty coal and cannot be considered valuable. This coal is exposed in the river bluff north of Brownsville, near the Pike mine (Cd2), where the section is 12 inches of coal overlain by 14 inches of clay, coal and bone layers. In the Brier Hill shaft (Ee6) it consists of 7½ feet of coal and shale; in the Republic shaft (Ce7) it is about 2 feet of coal and shale; in the Orient shaft (Df4) this bed is 3 feet thick with 10 inches of shale in the middle and in the Filbert hoisting shaft (Df5) the coal is 8½ inches thick.

Redstone coal. The Redstone coal is believed to be generally absent in Brownville and Redstone townships, as it was not found during the field work and none of the mine shaft sections report it. The horizon of this coal is believed to be 60 to 80 feet above the base of the Pittsburgh coal and to overlie a rather persistent limestone bed.

Sewickley coal. The Sewickley coal lies 130 to 150 feet above the base of the Pittsburgh coal bed and is a persistent but thin bed of dirty coal. The Sewickley coal is present in all the mine shaft sections in Brownsville and Redstone townships, ranging from 1 foot of coal in the Filbert airshaft (Df6) to 3½ feet of coal and shale in the Brier Hill shaft (Ee6). In a road cut 1¼ miles east of Brownsville, this coal crops out (Dd4) as a one-foot bed, of which the lower half is bone coal. From 1 to 6 feet of gray clay or shale directly overlies the Sewickley coal and this shale is overlain by limestone. The floor of the coal is dark clay or shale.

In the Filbert hoisting shaft (Df5), 2½ feet of coal is reported at 212 feet above the base of the Pittsburgh coal. This bed is the probable correlative of the Benwood coal and represents a local lens, as it was not seen or reported elsewhere in the area.

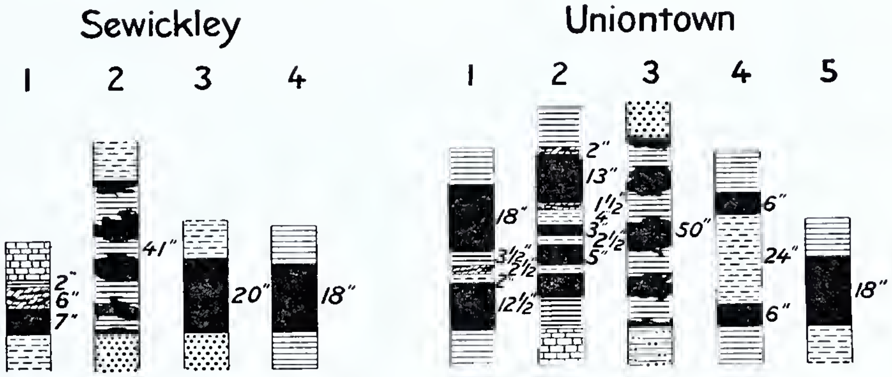

Figure 52. **Sections of Sewickley and Uniontown coals in Brownsville and Redstone Townships.**

Sewickley coal: 1. Dd4. 2. Ee6, Brier Hill shaft. 3. Ce7, Republic shaft. 4. Df5, Filbert hoisting shaft.

Uniontown coal: 1. Ce1. 2. Ce2. 3. Ee6, Brier Hill shaft. 4. Df5, Filbert hoisting shaft. 5. Df6, Filbert air shaft.

Uniontown coal. The Uniontown coal ranges from 275 to 310 feet above the base of the Pittsburgh coal and is very irregular in nature, varying from a thin moderately clean coal bed through dirty coal to a black shale. The black shale phase is reported in the Republic (Ce7) and Orient (Df4) shafts. Elsewhere in Brownsville and Redstone townships, the bed is believed to be more or less dirty coal. The Uniontown coal was opened for custom coal in a series of openings (Ce1, Ce2) one mile north of Allison, where the bed is 40 to 50 inches thick and considerably broken by shale, clay, and bone partings and binders. The immediate roof of the coal is gray shale 4 to 10 feet thick which is overlain by a drab medium-bedded sandstone. The floor of the coal is gray to dark clay or shale.

Waynesburg coal. The Waynesburg coal bed lies 370 to 405 feet above the base of the Pittsburgh coal and forms the top of the Monongahela formation. The Waynesburg coal is persistent through Brownsville and Redstone townships as a mineable bed, although in very local instances the overlying sandstone may cut down into the bed, removing part or all of the coal. In normal occurrence, the coal is overlain by 2 to 20 feet of gray to dark clay shale which is, in turn, overlain by heavy-bedded, coarse-grained buff sandstone. The floor of the coal is gray to dark clay or clay shale. The Waynesburg coal in the area is usually a double- but occasionally a triple-benched bed of indifferent coal, ranging from 4 to 7 feet in thickness. The third or top bench is never mined, as it is a bony, sulphurous coal and where present is only 4 to 10 inches thick. A clay and bone parting 1 to 7 inches thick

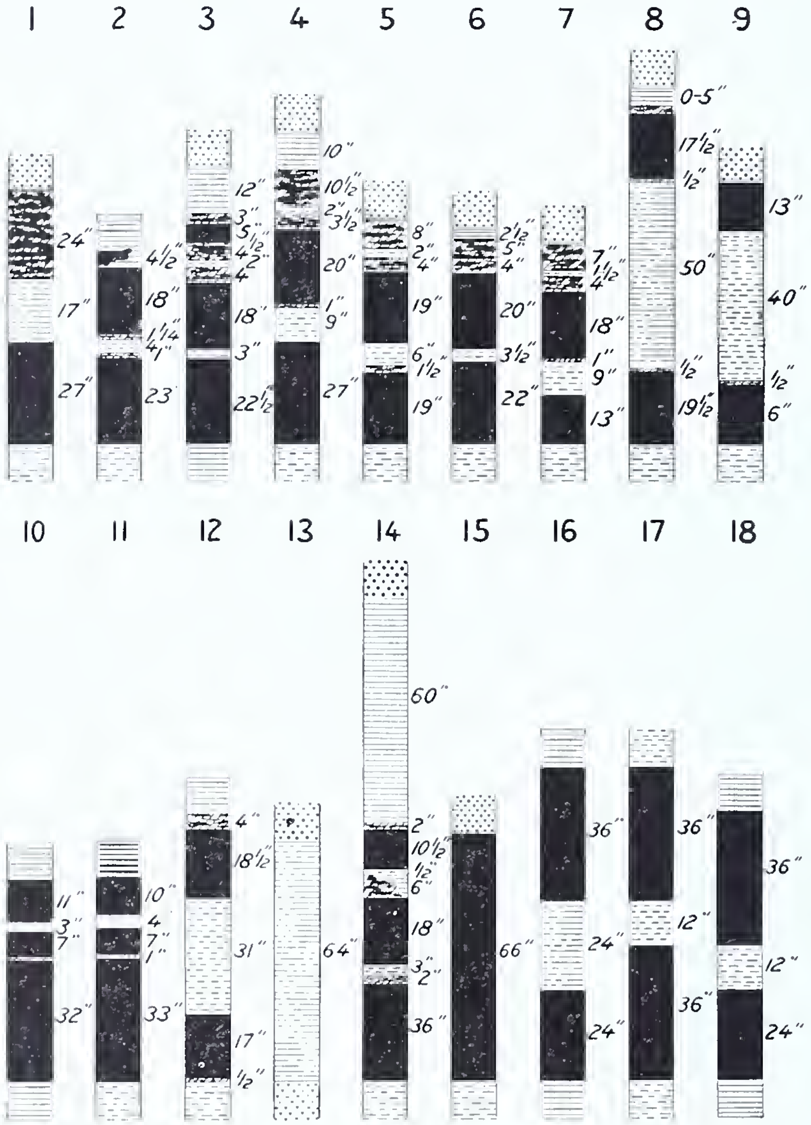

Figure 53. Sections of Waynesburg coal in Brownsville and Redstone Townships.

1. Ce3, Chalfant mine. 2. Dd8, Albright mine. 3. Dd5. 4. Dd6. 5. Dd10. 6. Dd15. 7. Dd12. 8. Ed9. 9. Ed8. 10. Ed6, Belbois mine. 11. Ee1, Cherry Camp mine. 12. Ee2. 13. Ee6, Brier Hill shaft. 14. Ce5. 15. Ce7, Republic shaft. 16. Df4, Orient shaft. 17. Df5, Filbert hoisting shaft. 18. Df6, Filbert air shaft.

separates the top from the middle or second bench. The middle bench ranges between 8 and 36 inches in thickness and it carries the cleanest coal of the bed, although shale streaks and "sulphur" balls are found locally. The coal is moderately hard. The top of this bench is usually marked by 1 to 5 inches of bone which has a dense, dull, blocky appearance and resembles cannel coal. In the plotted coal sections, this top layer is called bone. The bottom ½ to 1 inch of the middle bench is bone or bony coal. The lower and middle coal benches are separated by a gray clay or clay shale parting that ranges from 3 to 60 inches in thickness. This clay varies greatly in short distances, but generally the parting attains greater thickness in the southern and central parts than elsewhere in the area. The lower bench is 13 to 40 inches thick and consists of moderately dirty coal. The coal of this bench is hard and contains numerous shale streaks and "sulphur" balls. At some localities, it is nearly a bony coal. The top ½ to 2 inches of this bench is bone coal. In the Republic shaft (Ce7) the Waynesburg is reported to be 5½ feet thick with no partings, but this must represent an exceptional condition, as partings were found in all field observations. The Waynesburg coal has been mined commercially in the area, but because of the poor quality and high mining costs, it is boom-time coal.

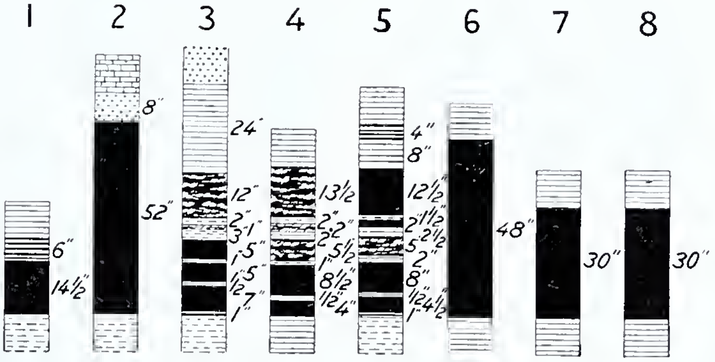

Figure 54. Sections of Waynesburg A coal in Brownsville and Redstone Townships.

1. Dd16. 2. Ee6, Brier Hill shaft. 3. Ef1. 4. Ef2. 5. Ef3. 6. Df5, Filbert hoisting shaft. 7. Df6, Filbert air shaft. 8. Df4, Orient shaft.

Sections 2, 6, 7 and 8 should be coal and shale or bone, not solid coal.

PERMIAN COALS

As a group, the Permian coals are valueless. They are poorly and seldom exposed, so that little is known concerning their make-up, except that they are as a rule thin, dirty and irregular in occurrence. Correlations of these coals as given in this report are by no means certain. However, the intervals, regardless of the name of the coal bed, are believed to be accurate. The Waynesburg A, Little Washington and Washington beds of the Washington group are the most persistent coals of the group and merit discussion.

Waynesburg A coal. The Waynesburg A coal lies 50 to 80 feet above the top of the Waynesburg coal bed and is believed to be persistent through Brownsville and Redstone townships. This bed ranges in thickness from 14½ inches (Dd16) near Redstone Creek to 52 inches of coal and shale reported in the Brier Hill shaft (Ee6). In the southeast corner of Redstone Township, in a series of custom openings (Ef1, 2, 3), the bed is 37 to 39 inches thick and composed of thin benches of coal separated by shale and bone partings. In the Filbert shafts (Df5, 6), the thickness is reported to be 30 and 48 inches. The normal roof of the Waynesburg A coal in the area is gray to dark shale, and the floor is either gray clay or shale.

Little Washington coal. Lying 135 to 140 feet above the top of the Waynesburg coal is the Little Washington coal. It correlates with the coal Stevenson (Report KK, Pa. 2d Geol. Survey) and Campbell (U. S. Geol. Survey, Folios nos. 82 and 94) called Washington coal. From the few obtainable observations, the Little Washington coal is 3 feet thick, has a dark to black shale roof and a clay or shale floor.

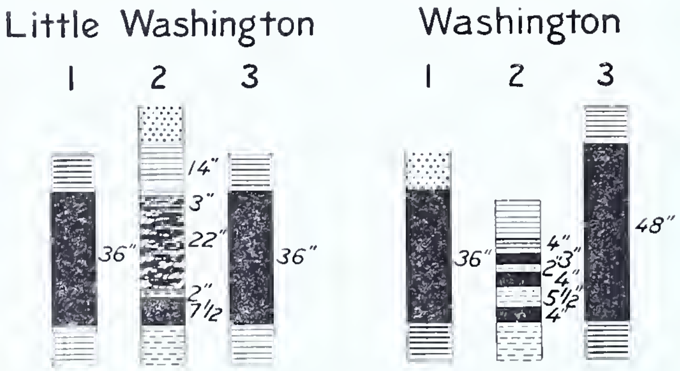

Figure 55. Sections of Little Washington and Washington coals in Brownsville and Redstone Townships.

Little Washington coal: 1. Ee6, Brier Hill shaft. 2. Df2. 3. Df6, Filbert air shaft.
Washington coal: 1. Ee6, Brier Hill shaft. 2. Df1. 3. Df6, Filbert air shaft.

In the southeast corner of Redstone Township, an opening shows the coal 35 inches thick with a clay parting near the base and many shale streaks through the entire bed.

Washington coal. The Washington coal lies 160 to 170 feet above the top of the Waynesburg coal and would correlate with the Washington A coal of Stevenson and Campbell. This coal is reported as 3 feet and 4 feet thick in the Brier Hill (Ee6) and Filbert air (Df6) shafts. An outcrop in the southeast corner of Redstone Township has a thickness of 18 inches, consisting of three coal benches separated by clay partings. Dark to black shale is the usual roof of the coal and the floor is either clay or black shale.

Clay and shale

Clay and shale deposits in Brownsville and Redstone townships apparently have little value and have not been developed. Mr. Leighton, in the general chapter on clay and shale, states that no fire clays occur above the Brush Creek horizon of the Lower Conemaugh formation except the main clay parting of the Pittsburgh coal bed. Consequently, this main clay parting is the only fire clay exposed in the area. It ranges from 2 to 24 inches in thickness and, although it was not tested, it is believed to be suitable for buff face brick and low-heat duty refractories. Some of the other clays and shales exposed in these townships could probably be used for ordinary brick.

Limestone

Numerous quarries have been opened on Monongahela and Permian limestones for agricultural lime. Physical tests show that some of these limestones are suitable for road metal.

The Fishpot limestone is from 10 to 30 feet thick in Brownsville and Redstone townships and is composed of 1- to 3-foot gray limestone beds separated by thinner gray clay shale beds. This limestone furnishes good agricultural lime and is satisfactory for road metal, but care must be taken to remove the clay shale beds for both purposes. It is opened near Smock in a small quarry (Ed11). Stevenson in Report KK describes a quarry (Cd) in the Fishpot limestone between Dunlap Creek and the National Pike in Brownsville Township. Here the limestone is 35 feet thick, with the basal 10 feet ferruginous and the remainder of the bed good, clean limestone.

The Benwood and Uniontown limestones have not been opened in the area, but would probably have been used for burning and for road metal.

The Waynesburg limestone is opened (Dd13) along Calvin Run, where the limestone contains a high percentage of interbedded clay shale which makes quarrying difficult. Its use is as agricultural lime. This limestone is not persistent and ranges from a film to 20 feet thick.

The Woodglen limestone of Permian time is irregular in occurrence and ranges in thickness from 0 to 9 feet. It contains some thin (up to 6 inches) interbeds of gray clay shale. A prospect pit (Ed4) on Calvin Run furnishes lime for farms.

The Lower Washington limestone has been opened (De12, 13) one mile east of Republic. It averages 10 feet thick and consists of gray limestone beds 2 to 3 feet thick, separated by 6 to 24 inches of shale and clay shale.

The Middle Washington limestone is not quarried in the area. An outcrop (Df9) ½ mile east of Tower Hill No. 1 was sampled (F13) and found suitable for road metal (see general discussion of the Middle Washington limestone for results). The sample represents 6 feet of hard, mottled, dark blue limestone taken from 10 feet of interbedded limestone and shale.

The Upper Washington limestone has been quarried at several localities (Df7, 3; De8, 9) in the high hilltops between the southwest corner of Redstone Township and the National Pike. In the quarry (De9), one mile southwest of Brier Hill, the section is from bottom to top 30 inches brownish gray limestone, 6 inches gray shale, 12 inches brownish gray limestone, 12 inches gray shale and limy shale, 34 inches brownish gray limestone, 18 inches carbonaceous shale, 10 inches black limestone, and 12 inches carbonaceous shale. The four limestone beds were sampled for chemical and physical analysis. The results are given in the general discussion of the Upper Washington limestone. This limestone furnishes good agricultural lime and is suitable for highway construction provided that care is taken to remove the shale interbeds.

Sandstone

Sandstone beds of Monongahela and Permian time have been quarried in Brownsville and Redstone townships for building stone and natural stone base for roads.

The Gilboy is stratigraphically the lowest sandstone quarried in the area. It averages 15 feet thick and has use as stone base on secondary roads. An inactive quarry (Ed7) on Row Run is the only opening on this sandstone.

The Waynesburg sandstone has been quarried at numerous localities for building stone and stone base for roads. It is well fitted for both uses. The sandstone is 10 to 60 feet thick and ranges from medium to coarse grained and medium to massive bedded. At present, the quarries on this sandstone are inactive. The larger quarries are as follows: Dd7, 1½ miles southeast of Brownsville; Dd11, on Colvin Run; De1, one mile north of Allison, and Ee4, one mile east of Brier Hill.

The Upper Mannington sandstone closely resembles the Waynesburg sandstone, but is only 5 to 20 feet thick. An inactive quarry (De6) one mile northeast of Davistown yielded stone base for secondary roads.

The Davistown sandstone is a coarse-grained, medium- to heavy-bedded sandstone from 10 to 30 feet thick. It is quarried near Davistown (De4, 5) and in the high hills one mile east of Cardale (De10, 11) for road stone. At some of the quarries it has desirable properties for building stone. In the quarry (De5) near Davistown, 20 feet of buff, fine-grained, medium-bedded sandstone were sampled (F72) for physical analysis, the results of which are listed in the general sandstone discussion.

The Dunlap sandstone was quarried (Ee7) just southeast of Brier Hill for secondary road base. This sandstone is a drab, micaceous, thin-bedded sandstone that averages 25 feet thick.

Oil and gas

The northwestern and extreme western parts of the area on and along the Brownsville anticline are the most likely sections for oil or gas drilling. The remainder of Brownsville and Redstone townships lies in the Lambert syncline, where the possibility of finding production is considerably lessened.

The first "oil and gas strike" in southwest Pennsylvania, according to Stevenson (Report KK, p. 234), was located in Brownsville Township on Dunlap Creek, where, in 1845, a hole was drilled for salt water, but obtained oil and salt water at 600 feet. The well was deepened to 786 feet, where a powerful jet of gas deranged the machinery and caused the loss of the tools, so that the work was abandoned.

Brownsville Township and the northwest corner of Redstone Township lie at the northern end of the area described as the Brownsville field in the general oil and gas chapter. The small dome (Dd) on the Brownsville anticline as shown on the economic geology map, terminates structurally the Brownsville field. This dome has 30 to 40 feet of closure at the surface. Deeper drilling is getting some gas from the Elizabeth sand, which is approximately 2,500 feet below the Pittsburgh coal. Sands lying at greater depth may prove productive in this area.

LUZERNE TOWNSHIP

Introduction

Luzerne Township is the middle one of the western border townships. It is bounded on the north and west by the meandering Monongahela River, on the south by German Township, and on the east by Redstone and Brownsville townships, from which it is separated by Dunlap Creek and Lilly Run. The geographic center of the township lies in map quadrilateral Ce. The borough of Bridgeport is included in this discussion.

The Monongahela River and its short tributaries drain all except the east quarter of the township. Dunlap Creek and Lilly Run drain that quarter. Along the Monongahela River bluffs rise 250 to 300 feet and are notched by the river's tributaries. The bluffs are very steep and prominent where the river is undercutting, and, though not nearly so noticeable, they are marked features on the slip-off slopes. The township is deeply dissected by the many short tributaries of the river. The upland has small flat-topped hills and knobs at altitudes between 1,200 and 1,250 feet. Dunlap Creek and Lilly Run have narrow valleys about 200 feet below the flat-topped hills.

Heavy materials are transported by flats and barges on the Monongahela River and by the Monongahela Railroad, which has lines along the river, Redstone Creek and Lilly Run, with a connecting branch from Tower Hill No. 1 (Cf) to the mouth of Wallace Run on the Monongahela (Bf). Most of the coal mined in this township is transported to the north on the river. The principle industry is coal mining, which is active in all parts of the township.

Structure

The rock structure of Luzerne Township consists of the gently sloping limbs of the Port Royal syncline and the Brownsville anticline, the two structures crossing the township in a northeast-southwest direction. The Port Royal synclinal axis enters from the north at the westernmost corner (Cd) of Bridgeport Borough and gradually loses 70 feet of structural elevation in its course through the township, which it leaves at Arensburg (Bf). The west limb of this structure rises gently at a maximum rate of 60 feet per mile to the Monongahela River, at LaBelle (Ad). From this point the Bellevernon anticlinal axis is only one mile northwest in Washington County. The east limb of the Port Royal syncline has a maximum inclination of 70 feet per mile to the Brownsville anticlinal axis, which enters Luzerne Township at Dunlap (Ce) and leaves at East Riverside (Bf) on the river. This axis loses 25 feet in structural elevation in the north half of its course through the township and then plunges more rapidly to lose 120 feet structurally until it leaves the county. The east limb of the Brownsville axis has the steepest slope in the township and it falls towards the Lambert syncline at a maximum rate of 160 feet per mile.

Stratigraphy

The exposed consolidated strata in Luzerne Township comprise a stratigraphic section of approximately 725 feet, which is divided into 40 feet of upper Conemaugh rocks, 390 feet of Monongahela formation, and 295 feet of the lower Washington group. The rocks range in age from the Upper Conemaugh formation of Pennsylvanian time to the middle of the Washington group of Permian time.

A diamond drill hole (Bd2) on the river flat near the Alicia No. 1 mine fan shaft, ½ mile south of Alicia, penetrates the Conemaugh and the upper half of the Allegheny formations, and gives a complete section of these unexposed strata.

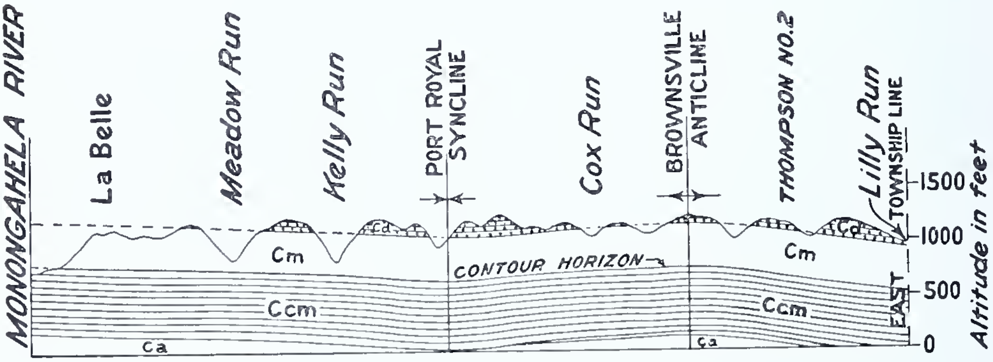

Figure 56. Structure section across Luzerne Township.

Legend: Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation.

The unconsolidated Carmichaels deposits of Pleistocene time occur in the township as several small terrace patches in the vicinity of Arensburg and East Riverside. Alluvial sand and gravel deposits of Recent time form the flood plain along the Monongahela River and at several points on Dunlap Creek and Lilly Run.

PENNSYLVANIAN

Allegheny formation. The only obtainable information on the Allegheny formation in Luzerne Township is the diamond drill hole (Bd2) near the Alicia No. 1 mine fan shaft, of which a complete section is plotted at the end of this stratigraphic discussion. The diamond drill hole penetrates the upper 121½ feet of the Allegheny formation, or to several feet below a coal correlated with the Upper Kittanning bed. The section shows the Upper Freeport coal 5½ feet thick and underlain by a 56-foot series of clays, shales and sandy shales to the Lower Freeport coal. Near the middle of this series, the Upper Freeport limestone occurs as a 9½-foot bed. The interval from the Lower Freeport to the Upper Kittanning coal is 59 feet and is occupied chiefly by sandy shale with minor beds of gray shale and sandstone. Midway in this interval at 29 feet below the Lower Freeport coal, there is a 2-inch bed of dark shale with coal streaks which is believed to be of local occurrence. Evidence against correlation of this 2-inch coal with the Upper Kittanning bed is the short interval to the Lower Freeport coal as compared with the interval of 53 feet in the drill records given in the discussion of Jefferson and Washington townships. The lowest coal in the record is correlated with the Upper Kittanning bed because the interval to the Lower Freeport coal compares closely with the Lower Freeport-Upper Kittanning interval found in Jefferson and Washington townships (59 feet to 53 feet). The greater Upper Freeport-Upper Kittanning interval of this drill record is caused by the increase in the Upper-Lower Freeport interval as compared with the same intervals in the records of Jefferson and Washington townships. Additional evidence for this correlation is the presence of the limestone bed 2½ feet under the bottom coal of the record. This limestone is correlated with the Johnstown limestone bed. No further detailed information is available on the Allegheny formation, but from records of oil and gas wells in Luzerne Township it appears that the Lower Kittanning coal is present 140 to 170 feet below the Upper Freeport coal and that the Allegheny formation has an approximate thickness of 225 feet.

Conemaugh formation. The upper 30 to 40 feet of the Conemaugh formation are above drainage at two localities in Luzerne Township, one in the northeast township corner (Cd) in the lower course of Dunlap Creek and for a short distance along the Monongahela River, and the other in the northwest township corner from Meadville (Ad) upriver till opposite Millsboro (Ae). However, at these localities most of the strata are concealed by the alluvial flood plain deposits and few outcrops can be found. A complete Conemaugh section is obtained from the diamond drill hole (Bd2) near the Alicia No. 1 mine fan shaft and plotted at the end of the stratigraphic discussion. This drill record shows the formation to be 630 feet thick and to consist mainly of shale, but with several sandy portions. The upper 170 feet of strata are for the greater part, dark to gray shale. The Lower Pittsburgh limestone member is about 15 feet thick, but mixed with shale, and the Clarksburg limestone is reported 4½ feet thick and lying 145 feet below the formation top. Underneath the shale series occurs the Morgantown sandstone, which is 80 feet thick and well developed. Below the Morgantown sandstone lie 130 feet of red and gray shales of which the prominent members are the Birmingham red shales, 13 feet thick, and the Pittsburgh red shales, 40 feet thick. A 4½-foot limestone and shale bed near the middle of this interval (325 feet above the Upper Freeport coal) may possibly correlate with the Ames limestone, although in the record it is not reported to be fossiliferous. The Saltsburg sandstone underlying the Pittsburgh "Reds" has a weak shaly character and overlies a 1-foot bed of fossiliferous shale which correlates with the Woods Run limestone of the Pittsburgh region. A $2\frac{1}{2}$-foot coal bed close beneath the Woods Run limestone is called the Woods Run coal. From the Woods Run coal down to the Brush Creek coal, the strata become increasingly arenaceous and the Buffalo sandstone has a good development 50 feet thick. The Brush Creek coal (local name Wilson Run coal) lies 92 feet above the Upper Freeport coal and is but 10 inches thick. The interval between the Brush Creek and Upper Freeport consists chiefly of weak sandstone or sandy shale with a bed of red shale at 65 feet above the Upper Freeport coal. This last sandy interval represents the Mahoning member of the Conemaugh formation.

Monongahela formation. The strata of the Monongahela formation crop out in all the northern and western parts of Luzerne Township, except the hilltops. As the structure plunges to the south and east, the Monongahela formation is exposed lower and lower in the hills until, in the southeast township corner, the formation is under drainage. The Pittsburgh coal bed at the base of this formation is a persistent bed 8 to 9 feet thick. It is separated from the overlying Pittsburgh sandstone by a film to 20 feet of shale which is persistent in the eastern part of the township, but often lacking in the western part. The Pittsburgh sandstone is well developed, ranging from 10 feet thick in the eastern half to 50 feet thick in the western half of the township, as shown in the Sarah air shaft (Be19) section. Along the Monongahela River, this sandstone is massive and coarse grained and is reported to be conglomeratic at some localities. The Pittsburgh Rider coal was not observed in outcrop, but is believed to be a thin, sporadic bed occurring 25 to 35 feet above the base of the Pittsburgh coal and in the Pittsburgh sandstone, as shown in the Sarah sections. Between the Pittsburgh sandstone and the Fishpot limestone, the interval is occupied by shales and clay shales containing an irregularly occurring limestone 3 to 10 feet thick which is believed to be the Redstone limestone. The Redstone coal was not observed in Luzerne Township. Stevenson's Redstone coal in the section south of LaBelle (Ad) is probably the Pittsburgh Rider coal. The Fishpot limestone averages 25 feet thick and is separated from the Sewickley coal by gray shale or an irregular sandstone 10 to 20 feet thick. The Sewickley coal is thin but persistent through the township. It is overlain by 130 to 140 feet of Benwood limestone with much interbedded shale and clay shale. The upper 100 feet of the Monongahela formation in Luzerne Township is composed chiefly of arenaceous sediments representing the Arnoldsburg, Uniontown, and Gilboy sandstone. However, the Uniontown and Little Waynesburg coals and the Uniontown and Waynesburg limestones have good local developments, but they are not persistent. The Waynesburg coal at the top of the formation is a persistent, thick bed through the township and is easily distinguishable by its double- and triple-bedded character and the overlying prominent sandstone.

PERMIAN

Washington group. The Washington group strata crop out only in the hilltops in the northern part of Luzerne Township, but descend

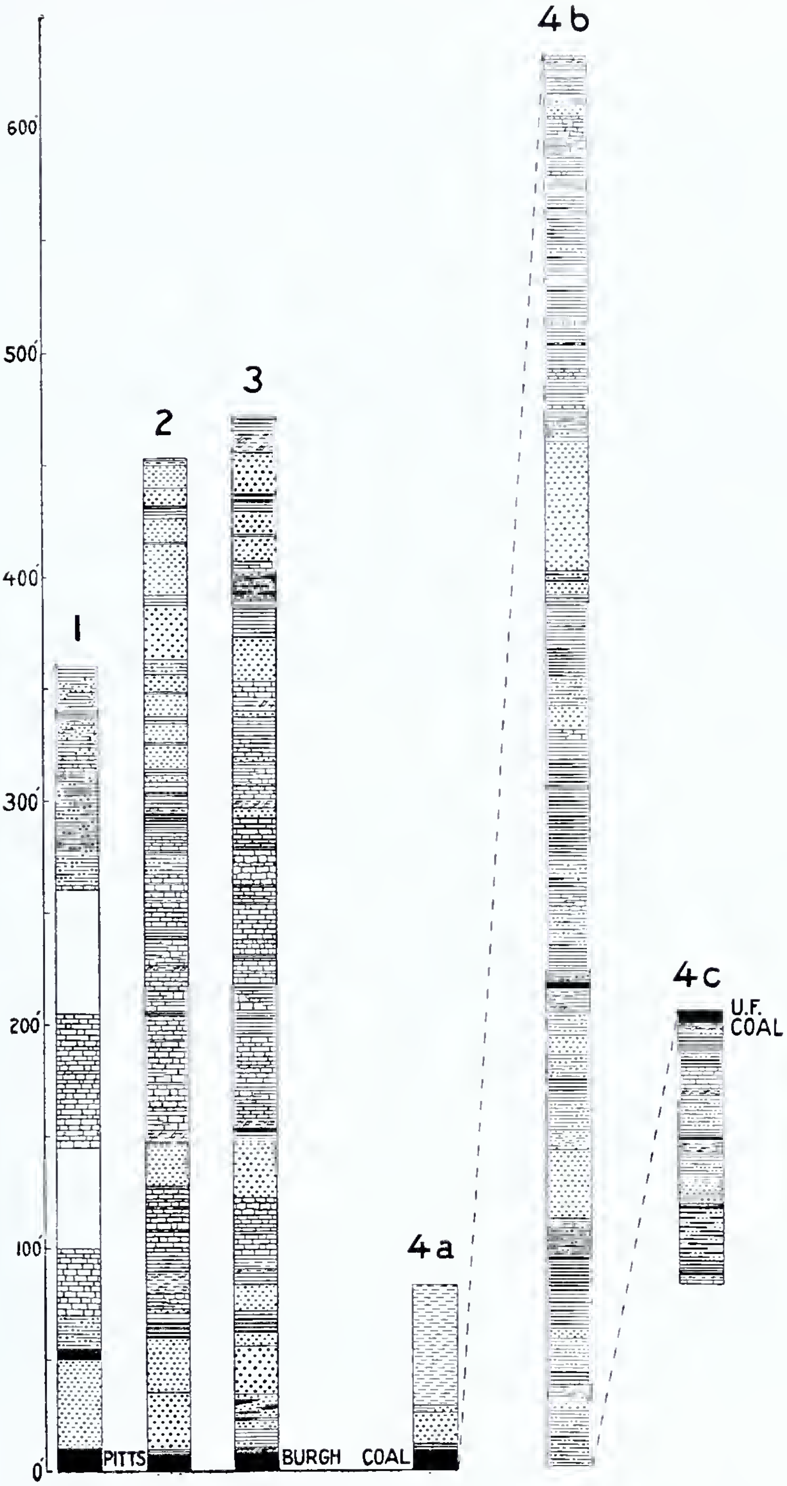

Figure 57. Stratigraphic sections in Luzerne Township.

1. Section of the Monongahela formation on the road leading up from the Monongahela River, opposite Fredericktown (Ad), as measured by J. J. Stevenson (Report KK, p. 239).

2. Section of the Monongahela formation and the lower Washington group in the Sarah air shaft (Be19). Courtesy of H. C. Frick Coke Co.

3. Section of the Monongahela formation and the lower Washington group in the Sarah hoisting shaft (Be18). Courtesy of H. C. Frick Coke Co.

4a. Section of the lower Monongahela formation in diamond drill hole, Bd2.

4b. Section of the Conemaugh formation in diamond drill hole, Bd2.

4c. Section of the upper Allegheny formation in diamond drill hole, Bd2. Drill record courtesy of Monessen Coal and Coke Co.

southward until they crop out in the stream valleys of the southeast township corner. Approximately 295 feet of this group is the greatest thickness found uneroded in the township. The Waynesburg sandstone is separated from the Waynesburg coal by a film to 20 feet of gray Cassville shale. The sandstone is a heavy- to massive-bedded, coarse-grained, buff to gray sandstone that is 20 to 50 feet thick. It is persistent through the township and frequently forms cliffs along the Monongahela River. Locally this sandstone cuts out some or all of the Cassville shale and Waynesburg coal. Above the Waynesburg sandstone the strata appear to be chiefly shales with some sandstones and thin, sporadic limestone beds. The Waynesburg A and Washington coals are generally found where there is sufficient altitude and they are believed to be persistent.

PLEISTOCENE

Carmichaels deposits. Small areas of Carmichaels deposits were observed as terraces along the Monongahela River in the vicinities of East Riverside and Arensburg. The base of the deposits lies 150 feet above the river, and the top limit of the clay and gravel is about 250 feet above the river. It is believed that only a thin cover of the deposits remains in these areas.

Coal resources

As the Conemaugh and Allegheny coals do not crop out in Luzerne Township, the following table of intervals between these coals is based on the diamond drill hole (Bd2) near Alicia. The Upper Freeport-Lower Kittanning and Brownsville-Clarion intervals are based on less exact information given on oil and gas well records.

Intervals to top of the Upper Freeport coal in Luzerne Township, in feet

Coal	Intervals
Woods Run	214
Brush Creek (Wilson Run)	92
Upper Freeport	0
Lower Freeport	58
Upper Kittanning	117
Lower Kittanning	150
Brookville-Clarion	255

The Monongahela coals are referred by interval to the base of the Pittsburgh coal which is the base of the formation and is the structure contour horizon in this township. The coals of the Washington group are referred to the top of the Waynesburg coal, which is the group's base.

Monongahela coal intervals to base of Pittsburgh coal in Luzerne Township, in feet

Coal	Average	Range
Waynesburg (top)	385	375 to 400
Little Waynesburg	355	345 to 365
Uniontown	285	280 to 295
Sewickley	140	125 to 150
Redstone horizon	85	80 to 90
Pittsburgh Rider	35	25 to 40
Pittsburgh	0	0

Washington group intervals to top of Waynesburg coal in Luzerne Township

Coal	Average	Range
Washington	155	150 to 160
Waynesburg A	65	55 to 75
Waynesburg (top)	0	0

ALLEGHENY COALS

The only information on the Allegheny coals in Luzerne Township is obtained from the diamond drill hole (Bd2) near Alicia. The oldest coal bed penetrated by this drill hole is the Upper Kittanning coal reported 0 to 10½ inches thick and overlain by 0 to 4½ inches of cannel shale. Its roof is dark shale and the floor is clay. The Lower Freeport coal is reported 19 inches thick, underlain by clay and overlain by 0 to 6 inches of dark shale with coal spars which is overlain by dark gray shale. The Upper Freeport is 5½ feet thick, has a clay floor and an immediate roof of 0 to 11 inches of black shale succeeded by dark sandy shale and shale. The Lower Kittanning and Brookville-Clarion coals are reported in a few of the logs of oil and gas wells, but no definite thickness figures are obtainable.

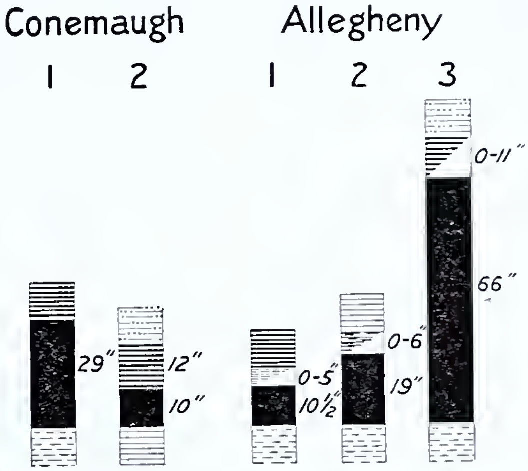

Figure 58. Sections of coals in Luzerne Township.

Conemaugh coals: 1. Woods Run coal. 2. Brush Creek coal.
Allegheny coals: 1. Upper Kittanning coal. 2. Lower Freeport coal. 3. Upper Freeport coal.

CONEMAUGH COALS

The diamond drill hole at Alicia supplies the only available information on the Conemaugh coals in Luzerne Township. It shows the Little Clarksburg coal as 8 inches of bony coal and 505 feet above the Upper Freeport coal, the Woods Run coal as 29 inches thick and 214 feet above the Upper Freeport coal, and the Brush Creek coal as 10 inches thick and 92 feet above the Upper Freeport coal. These are the only Conemaugh coals reported in the drill record.

MONONGAHELA COALS

The Pittsburgh and Waynesburg beds are the only persistent, mineable Monongahela coals in Luzerne Township. The Pittsburgh Rider, Sewickley, Uniontown and Little Waynesburg coals have sporadic occurrences, with no mineable thicknesses observed. The Redstone coal is missing in this township.

Pittsburgh coal. The Pittsburgh coal has been mined commercially for several decades. At present all the commercial coal production of the township is derived from this bed.

In the extreme eastern part of Luzerne Township, the roof of the Pittsburgh bed is from 6 to 20 feet of dark gray shale which is in turn overlain by a heavy-bedded, coarse-grained sandstone. To the west, this sandstone becomes massive-bedded and descends towards the Pittsburgh coal until along the Monongahela River the sandstone generally forms the immediate roof of the coal. Locally, in the western part of the township, dark gray to black shale up to 6 feet thick is the roof. The roof coal is lacking in a considerable part of Luzerne Township. This division is reported only from the LaBelle mine (Ad3) 2 to 18 inches thick, the Maxwell mine (Ad2) 0 to 10 inches thick, and Hustead mine (Ae3) 0 to 12 inches thick. In all other mines the overlying sandstone or shale is reported to rest directly on the middle division or main clay parting of the Pittsburgh bed, commonly known as ''draw slate.'' The main clay parting is persistent through the township, ranging from 2 to 24 inches and averaging 12 inches thick. It usually tends to cling to the underlying coal. The lower division of the Pittsburgh bed has a persistent regular occurrence through the township, ranging from 6½ to 9 feet thick, and generally it may be said to thicken towards the southeast. This division is subdivided from top to bottom into the breast coal, bearing-in coal, and bottom coal. The breast coal is from 35 to 70 inches thick and contains rather clean coal. Bone and shale partings, and ''sulphur'' streaks, up to 1 inch thick, occur at no regular horizon in the breast coal. Usually these partings are less than ¼ inch thick and are more numerous near the top of coal. In some mines along the Monongahela River the top 4 to 6 inches of the breast coal are so dirty that they are not mined, but are left as roof. The bearing-in coal is from 2 to 6 inches thick and is usually well marked by its accompanying slate bands ⅛ to ½ inch thick. The top slate band is persistent through the township, but the lower one is frequently missing and the bearing-in coal blends into the bottom coal. Because the brick and lower bottom coals are not distinguishable in the area, the portion of the lower division under the bearing-in bench is treated as the bottom coal. This bottom coal is 21 to 41 inches thick and contains some shale and ''sulphur'' partings up to ¼ inch thick. The basal 10 inches of the bench is often dirty with numerous ''knife edges'' of shale and in some instances, it is bony coal. Some of the mines on the river leave 4 to 6 inches of this dirty coal in place to serve as floor in the workings. The normal floor of the Pittsburgh bed is clay or shale, though not infrequently limestone forms the floor. The lower division of the Pittsburgh bed in Luzerne Township is hard, shiny coal that has a blocky appearance after mining.

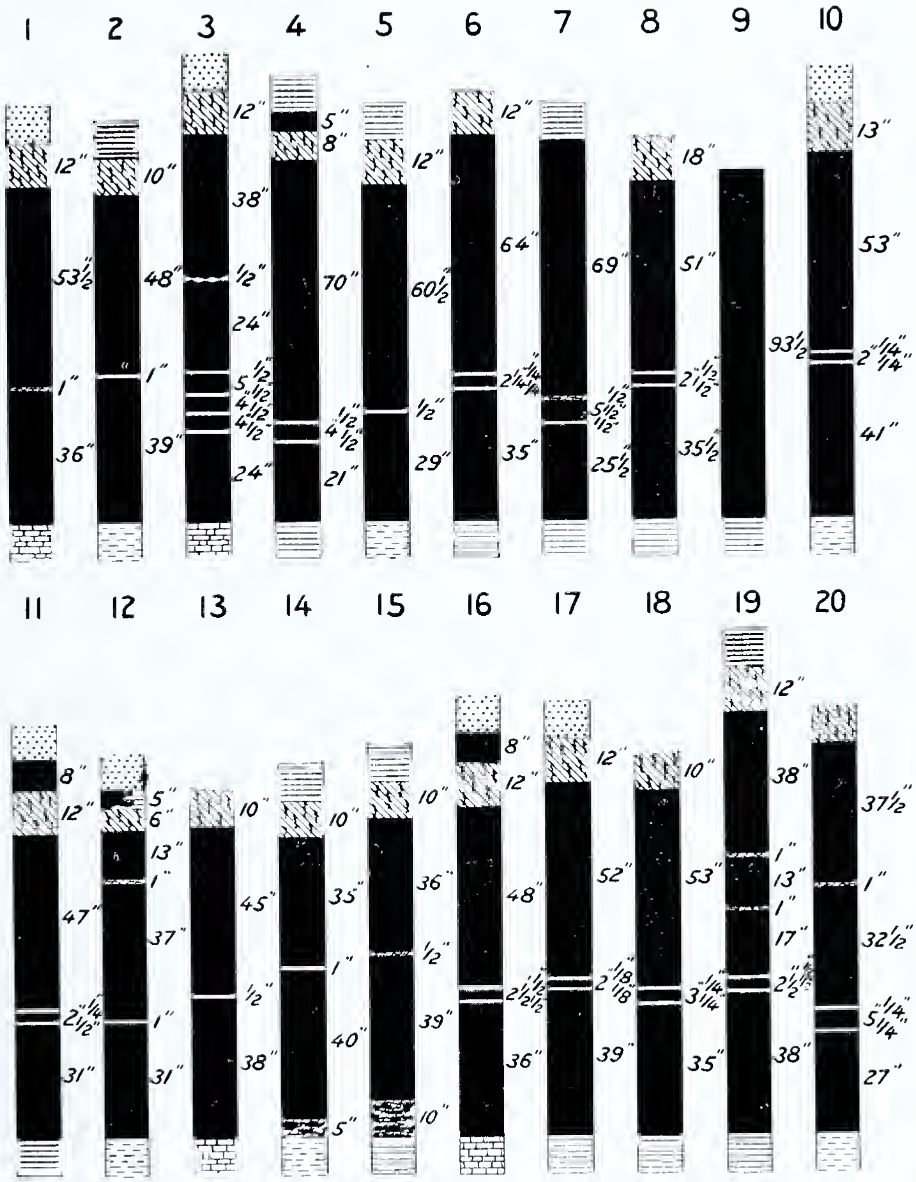

Figure 59. Sections of Pittsburgh coal in Luzerne Township.

(Note: Letters and numbers designating locations of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small county banks or prospects or outcrops.)

1. Cd4, Champion mine. 2. Cd5, Bridgeport mine. 3. Bd1, Alicia No. 1 mine. 4. Ce9, Sharpnack mine. 5. Ce10, Katharine mine. 6. Ce12, Allison No. 2 mine. 7. Ce16, Tower Hill No. 2 mine. 8. Be1, Melrose mine. 9. Be19, Sarah air shaft. 10. Ad1, Luzerne mine. 11. Ad2, Maxwell mine. 12. Ad3, La Belle mine. 13. Ad4, Blackstone mine. 14. Ae1, Moore mine. 15. Ae2, Ferry mine. 16. Ae3, Hustead mine. 17, Bf5, Isabella mine (near shaft). 18. Bf5, Isabella mine (east side). 19. Cf5, Thompson No. 2 mine. 20. Cf7, Thompson No. 1 mine.

Pittsburgh Rider coal. The Rider coal lying about 35 feet above the Pittsburgh coal is valueless, thin, and of local occurrence. In the Sarah air shaft (Be19) it occurs as a 4-inch coal in the Pittsburgh sandstone, and in the Sarah hoisting shaft (Be18) its horizon is marked by an 8-inch bed of shale and coal overlain by 10½ feet of sandstone with coal streaks.

Sewickley coal. The Sewickley coal lies 140 feet above the Pittsburgh bed and has a thin local occurrence in Luzerne Township. In the Sarah hoisting shaft (Be18) it is 7 inches thick, in the Sarah air shaft (Be19) 6 inches thick, and at the mouth of Rush Run an outcrop (Bd4) shows a 20-inch bed consisting chiefly of bone and shale.

Uniontown coal. The Uniontown coal is a thin, local bed in Luzerne Township and lies 285 feet above the Pittsburgh coal. In the Sarah air shaft (Be19) it is reported 3 inches thick and along Rush Run a coal prospect exposes four thin coal benches, each less than 7 inches thick and separated by clay partings, of which the middle one is 30 inches thick.

Waynesburg coal. The Waynesburg bed is a generally persistent, mineable coal that lies 375 to 400 feet above the Pittsburgh bed. It is a "boom-time" coal and has been mined commercially during such periods. The normal roof of the Waynesburg coal is gray to dark shale and clay shale, ranging in thickness from 0 to 15 feet, but averaging less than 2 feet thick. This shale is overlain by the heavy- to massive-bedded, coarse-grained Waynesburg sandstone which has an irregular base that cuts down into and replaces the underlying shale. In many instances this sandstone rests directly on the Waynesburg coal and in a few places the sandstone has replaced part or all of the coal bed, as is shown in the Sarah air shaft (Be19) where the Waynesburg coal is not reported, or in the Sarah hoisting shaft (Be18) where the Waynesburg coal horizon consists of 13 feet of sandstone containing coal streaks. In normal occurrence, the Waynesburg coal consists of three benches of solid coal separated by clay or clay shale partings. The top bench is up to 12 inches thick and is not mined, as it consists of bony coal containing many shale streaks. Locally this bench may be lacking. It is separated from the middle bench by a clay or shale parting from 1 to 5 inches thick. The middle bench is from 12 to 25 inches thick and contains numerous thin shale partings and streaks which give the coal a rather dirty appearance. Frequently the top 2 to 4 inches and the bottom ½ to 1 inch of this bench are bony coal or bone. The middle and bottom coal benches are separated by 2 to 36 inches of gray clay or clay shale parting which varies greatly in thickness in short distances and averages approximately 9 inches thick. The bottom coal bench is from 20 to 39 inches thick and contains the best coal of the bed. Commonly, the top ½ to 2 inches is bony coal and some shale lenses and partings occur through the bench. In a few localities a lensy clay parting up to 7 inches thick was observed occurring 3 to 5 inches above the base of the bottom bench. The floor of the Waynesburg bed is usually gray clay, but locally dark to black shale underlies the coal.

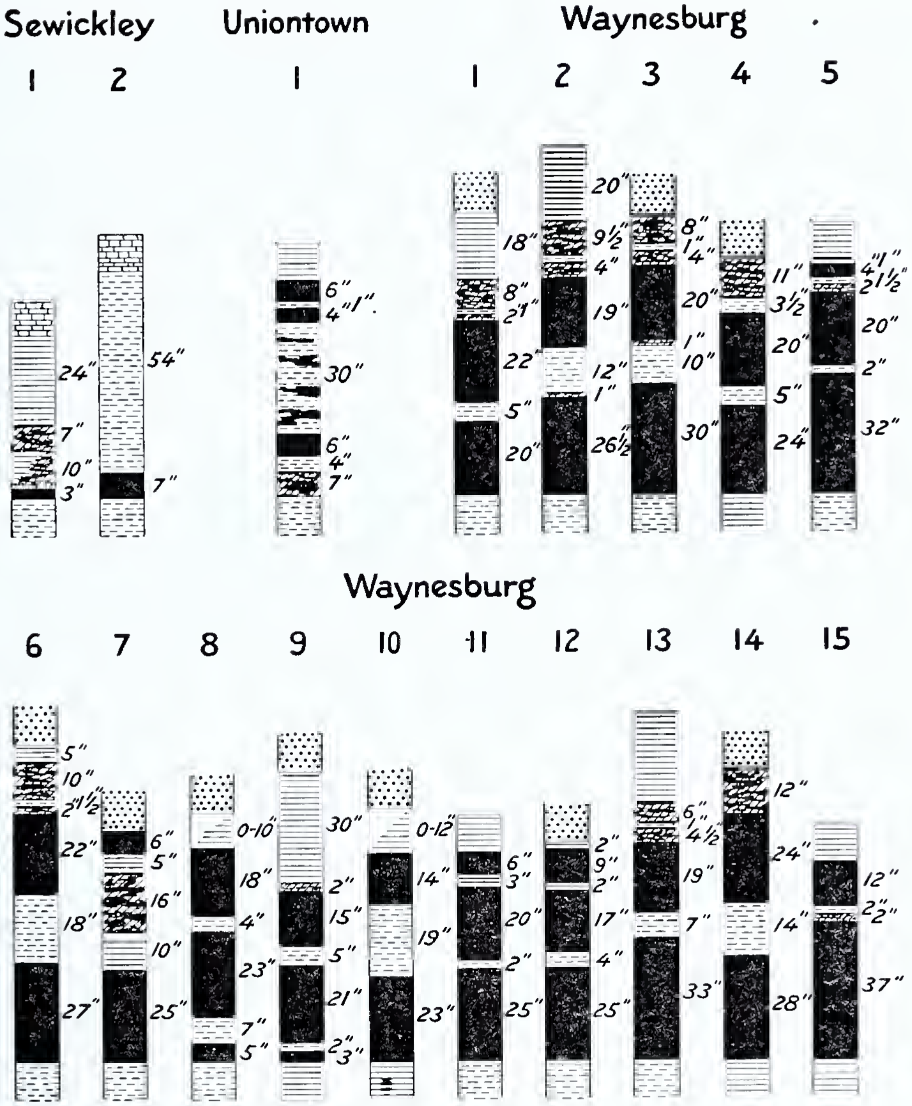

Figure 60. Sections of Monongahela coals in Luzerne Township.

Sewickley coal: 1. Bd4. 2. Be18, in Sarah hoisting shaft.
Uniontown coal: 1. Be2.
Waynesburg coal: 1. Bd3, Colbert mine. 2. Ce14. 3. Ce17. 4. Be4. 5. Be11. 6. Be15. 7. Be20, Sarah mine. 8. Ae4. 9. Ae5. 10. Ae10. 11. Ae4, Arensburg mine 12. Bf1, Frances mine. 13. Bf7. 14. Bf11, Christopher mine. 15. Cf13.

WASHINGTON GROUP COALS

The only persistent coals of the Washington group are the Waynesburg A and Washington beds. The other coals of this group are thin and believed to have a local lens-like character.

Waynesburg A coal. The Waynesburg A coal lies 55 to 75 feet above the top of the Waynesburg coal. It ranges in thickness from 20 to 40 inches and consists of dirty coal containing many thin black shale partings or streaks so that the entire bed may be classed as bone coal. Locally, clay lenses up to 2 inches thick occur in the bed. The floor of the coal is clay. The roof is drab shale 1 to 10 feet thick and is overlain by limestone.

Washington coal. The Washington coal was measurable at only one locality (Cf11) in the southern part of the township where a road outcrop exposed 23 inches of dirty coal containing much black shale as thin partings. An abandoned opening (Cf8) in the southeast township corner indicates a mineable thickness in that section. The Washington coal lies about 155 feet above the top of the Waynesburg coal.

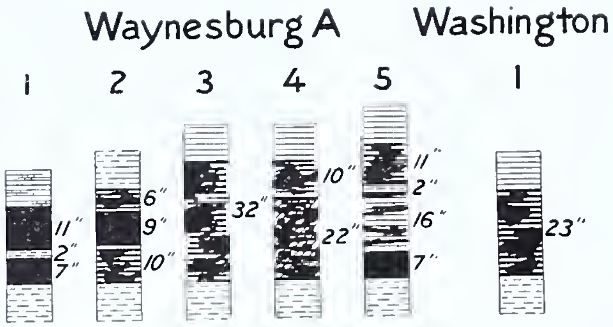

Figure 61. Sections of Washington coals in Luzerne Township.

Waynesburg A coal: 1. Ce15. 2. Be12. 3. Be17. 4. Bf9. 5. Cf12.
Washington coal: 1. Cf11.

Clay and shale

The only refractory clay exposed in Luzerne Township is the main clay parting or ''draw slate'' of the Pittsburgh coal bed. It averages 12 inches thick in the township and is very persistent. This clay parting has never been utilized in the area and no tests on it are available.

The numerous shale and clay shale beds of the Monongahela formation and Washington group would probably provide suitable material for face and building brick. No tests were made on the shales and clays of this township.

Limestone

The limestone members of the middle Monongahela formation are well developed in Luzerne Township and they are easily available in its western and northern parts. Of these limestones, only the Benwood member has been quarried. Inactive quarries are found on Cox Run (Ce8), near Merrittstown (Ce13), and near the mouth of Minnow Run (Bf6).

The limestones of the Washington group are not well exposed. They are believed to be thin and have an irregular occurrence.

Sandstone

The Monongahela sandstones that have been quarried in Luzerne Township are the Uniontown and Gilboy members. Only one quarry (Be3), along Rush Run, is actively operating on the Uniontown sandstone. Here 15 feet of massive, gray, fine-grained, micaceous sandstone were sampled. The results of physical tests (sample F-34) are given in the general sandstone chapter and show the rock to be suitable for native stone base for road construction purposes. The massive sandstone is overlain by about 10 feet of thin-bedded, fine-grained, micaceous sandstone that was not included in the sample.

An active quarry (Cf9) on the Gilboy sandstone, near the head of Wallace Run, shows 18 feet of massive, coarse-grained, gray sandstone overlain by 12 feet of medium-bedded gray sandstone. The results of physical tests on sample F-35, taken from the quarry, are given in the general sandstone chapter and show this sandstone to be suitable for any highway construction.

The Waynesburg sandstone of the Washington group is persistent through Luzerne Township and ranges from 20 to 50 feet in thickness. It is a heavy- to massive-bedded, gray to buff, coarse-grained sandstone. There are two active quarries in this sandstone in the area. One (Ce19) near Tower Hill No. 2 exposes 25 feet of heavy- to massive-bedded, buff to gray, coarse-grained sandstone that exhibits some cross-bedding. The second quarry (Ae7) shows 20 feet of typical gray, hard Waynesburg sandstone. Results of physical tests on sample F-14 taken from quarry Ce19 and on sample F-33 from quarry Ae7 are given in the general sandstone discussion.

Oil and gas

The West Luzerne gas field in the western part of Luzerne Township, on the west limb of the Port Royal syncline, has produced gas from its discovery in 1917 up to date of writing. The Brownsville gas field, which includes the West Brownsville and Antrim Run fields, extends north and south through the central part of Luzerne Township. It is on the Brownsville anticline. Production from both these fields has been obtained from progressively deeper sands which are correlated with the Big Injun, Murrysville, Fourth, Fifth and Bayard sands of the drillers. More detailed information on the gas fields of Luzerne Township is given in the general oil and gas chapter.

GERMAN AND MENALLEN TOWNSHIPS

German and Menallen townships are discussed as a unit because of the similarity of underlying structure and outcropping strata in both. They lie in the central-western part of Fayette County, extending northeast from the Monongahela River and Cats Creek to the middle course of Redstone Creek. The approximate center of German Township is in map quadrilateral Dg and that of Menallen Township in map quadrilateral Ef.

The western part of the area is drained by the Monongahela River and its tributaries, Middle Run, Browns Run and Cats Creek. Dunlap Creek rises in the central part of the area and drains it to the northwest. The eastern part of the area is drained by Redstone Creek and Jennings Run, which form the eastern boundary of Menallen Township.

The Monongahela River is bordered by bluffs that rise 300 to 400 feet above the river to a general level of more or less rounded hilltops at altitudes between 1,100 to 1,200 feet. Within two miles of the river, the altitude of these hilltops increases to 1,250 and 1,300 feet, which general level persists through the area. Middle Run, Browns Run, and Cats Creek have narrow, steep-sided lower courses with comparatively wider and more gentle slopes in the upper reaches. The headwaters of Dunlap Creek flow through fairly wide valleys with gently sloping sides. Along Redstone Creek and the lower course of Jennings Run, the valley sides rise steeply from the streams to the hilltops. The upper valley of Jennings Run has gentle slopes and a wide, nearly level floor.

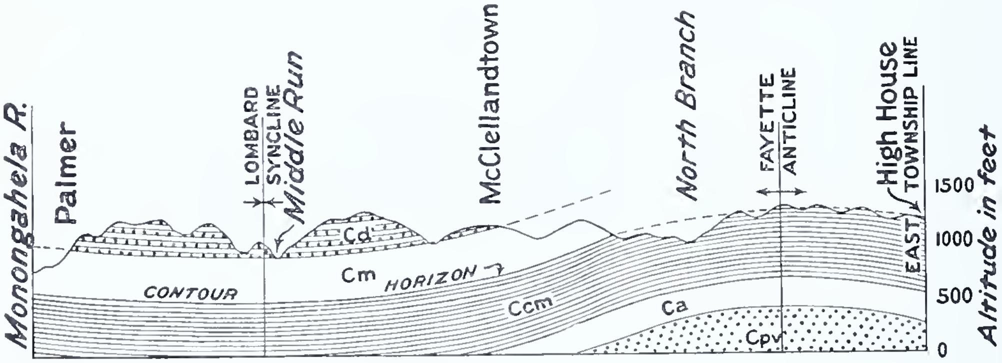

Figure 62. Structure section across German Township from northeast to southwest.

Legend: Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation.

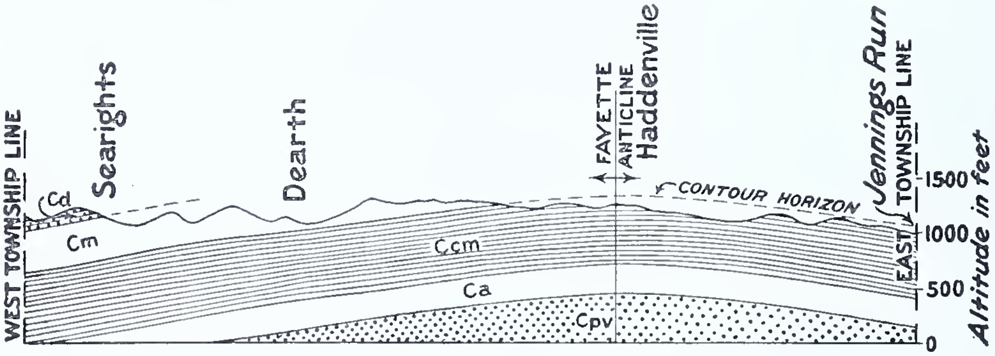

Figure 63. Structure section across Menallen Township from northwest to southeast.

The principal industries of German and Menallen townships are coal mining and beehive coke manufacturing. The area is a good agricultural section. Railroads serving these townships are the Monongahela Railroad and its branches along the Monongahela River, Middle Run, Browns Run, Cats Creek, Dunlap Creek and Redstone Creek, and a branch of the Baltimore & Ohio Railroad along the South Branch and Browns Run to the Monongahela River.

Structure

The Lambert synclinal axis passes through the northwest corner of German Township, entering just east of Dearth (Cf) and leaving at Gates (Bg), after rising 125 feet structurally in its southwest course through the township. This syncline has a wide flat bottom with a gently sloping west limb and an east limb that rises rapidly to the Fayette anticline. In the east part of German and Menallen townships, the Fayette anticlinal axis pursues a southwest course passing through Upper Middletown (Fe), Haddenville (Ef), Balsinger (Eg), and just west of Cores School (Eh). The axis undulates through two small domes of 10- to 20-feet closures, north and south of Haddenville and a third dome of 50-feet closure between the North and South Branches (Eh) of Browns Run. Structurally, the axis loses 100 feet in its southwest course through the area. The crest of the anticline is relatively narrow with a maximum width of half a mile. The limb between the Lambert synclinal axis and the Fayette anticlinal axis is steep, with a maximum rise of 360 feet to the mile. East of the Fayette anticlinal axis, the strata are less steeply inclined to the east boundaries of the townships.

Stratigraphy

The exposed consolidated strata in German and Menallen townships comprise a stratigraphic section of approximately 1,300 feet, ranging in age from middle Conemaugh of Pennsylvanian time to Greene group of Permian time. Unconsolidated sediments are represented by Carmichaels deposits of Pleistocene age and alluvium of Recent age.

PENNSYLVANIAN

Allegheny formation. The Allegheny formation does not crop out and little is known about its character except that it is dominantly shale in the upper half and sandy in the lower half. The only available information is the record of a cable-drilled well (Dg 13) that is reported to have been logged with particular care. This record records the Upper Freeport coal as 3 feet thick and underlain by 14 feet of fire clay, which is underlain by 170 feet of shale. Below the shale is a 40-foot sandstone bed underlain by 100 feet of shale and sandy shale to an 8-foot bed of coal and shale which is very doubtfully correlated with the Brookville-Clarion horizon. This lower coal may equally well represent the Mercer horizon of the Pottsville formation. To call it Brookville-Clarion coal assigns a 336-foot thickness to the Allegheny formation which does not agree with thicknesses on the Fayette anticline or in the diamond drill holes discussed under Jefferson and Washington townships. No other coals are reported between the Upper Freeport and this lower coal. As it is very generalized, the reader should not place too much confidence in this record, which is reproduced in the oil and gas discussion of these townships.

Conemaugh formation. The Conemaugh formation is exposed on the Fayette anticline in an area 1½ to 2 miles wide along the east boundaries of the townships between Redstone and Cats Creeks. In the southern part of the area the formation crops out only on the hillslopes and the Monongahela formation caps the hills. The greatest thickness exposed is not more than 475 feet in the hills along Redstone Creek. The oil and gas prospect hole (Dg 13) near Puritan shows the lower 215 feet of this formation as sandstone overlain by 60 feet limy shales and shells. The record of this well when tied into the structure on the Pittsburgh coal gives the formation a total thickness of 615 feet. Along Redstone Creek, exposures show the Saltsburg member to be 50 to 60 feet of medium to heavy coarse-grained sandstone underlain by dark shales and overlain by the Pittsburgh red beds. In this vicinity, the Ewing and Barton limestones, the Birmingham red shale, the Bakerstown, Harlem, and Barton coals, and the Morgantown and Connellsville sandstones all have good developments. Two measured sections along highway route 51 are presented in the general discussion of Conemaugh stratigraphy. Little is known concerning the Conemaugh formation south from Redstone Creek, as exposures are poor. The Morgantown and Connellsville sandstone members appear to be persistent through the area.

Monongahela formation. The Monongahela formation crops out in a strip ½ to 1½ miles wide extending from Smock (Fe) on Redstone Creek southwestward through the western part of Menallen Township and the central part of German Township to Browns Run (Ch), where its outcrop broadens to occupy the southwest corner of German Township. The upper members of the formation are exposed in the bluffs along the Monongahela River and for a short distance up the valleys of Middle and Antrim Runs. South of Sandy Hill (Fg), the lower members of this formation carry over the Fayette anticline into the Uniontown syncline as isolated patches occupying the highest hilltops. The Pittsburgh coal at the base of the formation is persistent and easily recognized. Overlying the Pittsburgh coal are 40 to 55 feet of dark to gray shales and sandy shales with local sandstones. The Pittsburgh Rider coal occurs in this shale series as a locally developed bed 20 to 35 feet above the Pittsburgh coal. The Pittsburgh sandstone is well developed in northwest German Township, but elsewhere in the area it has only a local occurrence as shaly to medium-bedded sandstone. Above the shale series lies the Redstone limestone, which is a persistent bed from 5 to 15 feet thick. The Redstone coal is best developed in the southern part of German Township, where it is 4 feet thick. This bed is fairly persistent except in the area around the Palmer shafts. The interval between the Redstone and Sewickley coals is occupied by 10 to 30 feet of gray clay shale at the base, 4 to 50 feet of Fishpot limestone and up to 40 feet of Sewickley sandstone. The Fishpot limestone is well developed in Menallen Township, but is thinner toward the Monongahela River. The Sewickley sandstone is best developed along the Monongahela River, from which it thins to the east and northeast and is missing in the northern part of the area. The Sewickley coal is present all through the area except northwest of Middle Run. It is a thin bed in the north part of the area, but thickens to the south and attains thicknesses of 6½ feet along the southern boundary. Between the Sewickley and Uniontown coals lies the persistent Benwood limestone 100 to 150 feet thick, containing its characteristic interbedded shale and clay shale, the fairly persistent Arnoldsburg sandstone up to 15 feet thick, and a good development of the Uniontown limestone from 10 to 15 feet thick. The Uniontown coal is reported only in the area west and northwest of McClellandtown (Dg) and it is apparently lacking elsewhere. Between the Uniontown and Waynesburg coals, the Uniontown sandstone has a very local thin occurrence, the Waynesburg limestone is thin but persistent, and the Gilboy sandstone is thin and local in occurrence. The Little Waynesburg coal is generally lacking from this interval, which is composed largely of shale. The Waynesburg coal at the top of the formation is a thick persistent bed. The Monongahela formation has an average thickness of 390 feet through all the area except along Middle Run, where the thickness increases locally to 430 feet. This greater thickness is purely local and decreases in all directions to the normal thickness.

PERMIAN

Washington group. The Washington group of strata crops out along the west line of Menallen Township and the entire northwest third of German Township. The Cassville shale overlying the Waynesburg coal is a persistent dark to light-gray shale and clay shale, from 5 to 40 feet thick, and characterized by abundant plant remains in the lower beds. The Waynesburg sandstone is separated from the Cassville shale by the thin, sporadic Elm Grove limestone, and is reported in the mine shaft sections in the area as a thin member split by shale beds. However, field observations prove this sandstone to be generally present as a medium-bedded fairly prominent member up to 25 feet thick. Above the Waynesburg sandstone, the Mt. Morris limestone and sandstone occur locally and underlie the Waynesburg A coal, which is a persistent, fairly thick bed. Between the Waynesburg A and B coals, the Calvin Run and Woodglen limestone members have good developments. The Waynesburg B coal is thin but fairly persistent. It is overlain by the Upper Mannington sandstone, which attains 5- to 20-foot thicknesses. The Little Washington and Washington coals appear to be fairly persistent. Little is known of the strata above the Washington coal, as exposures are poor. These higher strata of the group appear to be chiefly shale with some limestone and sandstone beds. The Upper Washington limestone is recognized in the highest hilltops in the vicinity of Dearthtown (Cf) and Lambert (Dg). The total thickness of the Washington group in German and Menallen townships is about 400 feet.

Greene group. The Greene group crops out only in the high hilltops in the vicinity of Dearthtown, where the greatest thickness remaining uneroded is not more than 75 feet. Little is known of the character of these strata except that they appear to be shale and sandy shale.

Carmichaels deposits. A large area of Carmichaels deposits is found in southwest German Township beginning at the mouth of Big Run and extending east around Masontown, where the abandoned

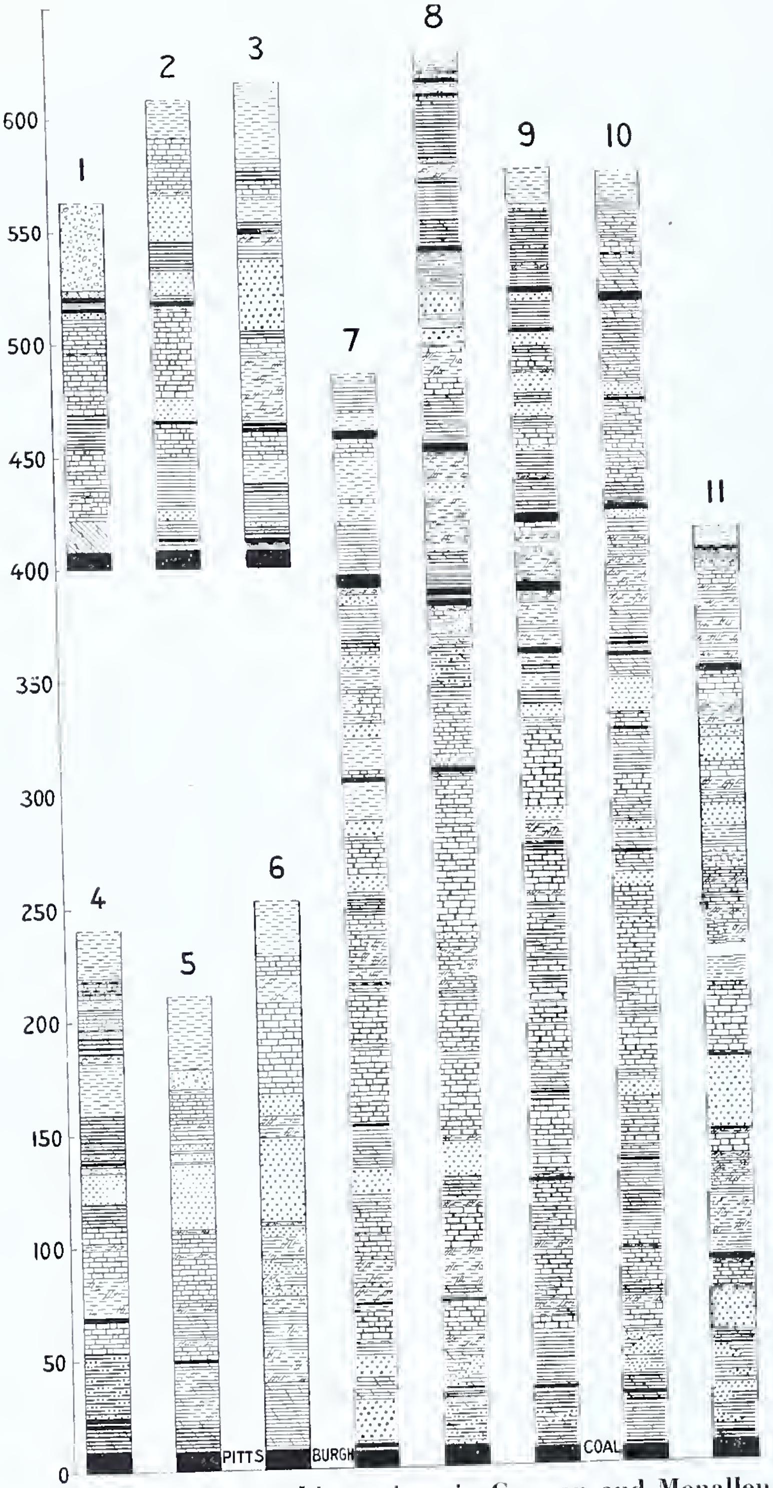

Figure 64. Stratigraphic sections in German and Menallen Townships.

1.	Donald shaft No. 4;	Whyel Coke Co.	(Bg3)
2.	Ronco new air shaft;	H. C. Frick Coke Co.	(Bh1)
3.	Ronco shaft No. 1;	do	(Bh2)
4.	Gates shaft No. 1;	do	(Cg15)
5.	Palmer air shaft;	do	(Bg6)
6.	Palmer hoisting shaft;	do	(Bg3)
7.	Edenborn shaft No. 1;	op	(Bg4)
8.	Lambert shaft No. 1;	do	(Dg1)
9.	Ralph hoisting shaft;	do	(Cf14)
10.	Ralph air shaft;	do	(Cf15)
11.	Buffington shaft No. 1;	do	(Df15)

meander turns south and then west along the south side of Cats Creek to the Monongahela River. The top of this deposit is 275 feet above the present level of the river. It consists of a clay, sand and gravel which appear to be poorly sorted. The thickness of the deposit is not known.

Igneous rocks. A thin dike or dike zone of mica peridotite porphyry cuts through the strata in western German Township extending northwest from Edenborn (Cg) to beyond the county line north of Adah (Bg). It pinches out to the southeast in the Edenborn mine. To the northwest it is well exposed in the workings of the Edenborn (Cg15) and Gates (Bg5) mines on the Pittsburgh coal and at the surface in the valley of Middle Run and near Adah. In this direction, the last exposure is found "at an opening in the Waynesburg coal near the head of a small ravine in Greene County, on the west bank of the Monongahela River, about ¾ mile north of Browns Ferry."[1] The dike zone consists of one to three dikes affecting an area up to 100 feet wide. The maximum observed thickness of any single dike was 20 feet, but this is exceptional, the average thickness being much less. The age of the intrusion is obscure and can only be placed as post-Paleozoic and pre-Glacial. A discussion of the occurrence, petrography and effects of the intrusive dikes is given in the stratigraphy section of this report.

Coal Resources

Little is known concerning the intervals of the Allegheny and Conemaugh coal beds. Gas well logs show the Pittsburgh-Upper Freeport interval as 590 to 620 feet. Along Redstone Creek, the Bakerstown coal lies approximately 430 feet and the Harlem coal 290 feet below the Pittsburgh coal. These are the only mineable Conemaugh coals.

The following tables give intervals for the more persistent Monongahela and Permian coals.

Monongahela coal intervals to base of Pittsburgh coal in German and Menallen Townships, in feet

Coal	Average	Range
Waynesburg	400	350 to 425
Uniontown	295	270 to 315
Sewickley	140	115 to 155
Redstone	70	50 to 85
Pittsburgh Rider	30	20 to 35
Pittsburgh	0	0

Permian coal intervals to top of Waynesburg coal in German and Menallen Townships, in feet

Coal	Average	Range
Jollytown	335	305 to 365
Washington A	240	225 to 250
Washington Rider	185	170 to 210
Washington	160	150 to 165
Little Washington	135	130 to 140
Waynesburg B	110	100 to 115
Waynesburg A	60	30 to 80
Waynesburg	0	0

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[1] Smith, L. B., A peridotite dike in Fayette and Greene Counties: Topog. and Geol. Survey Comm., Report 1910-1912, p. 154.

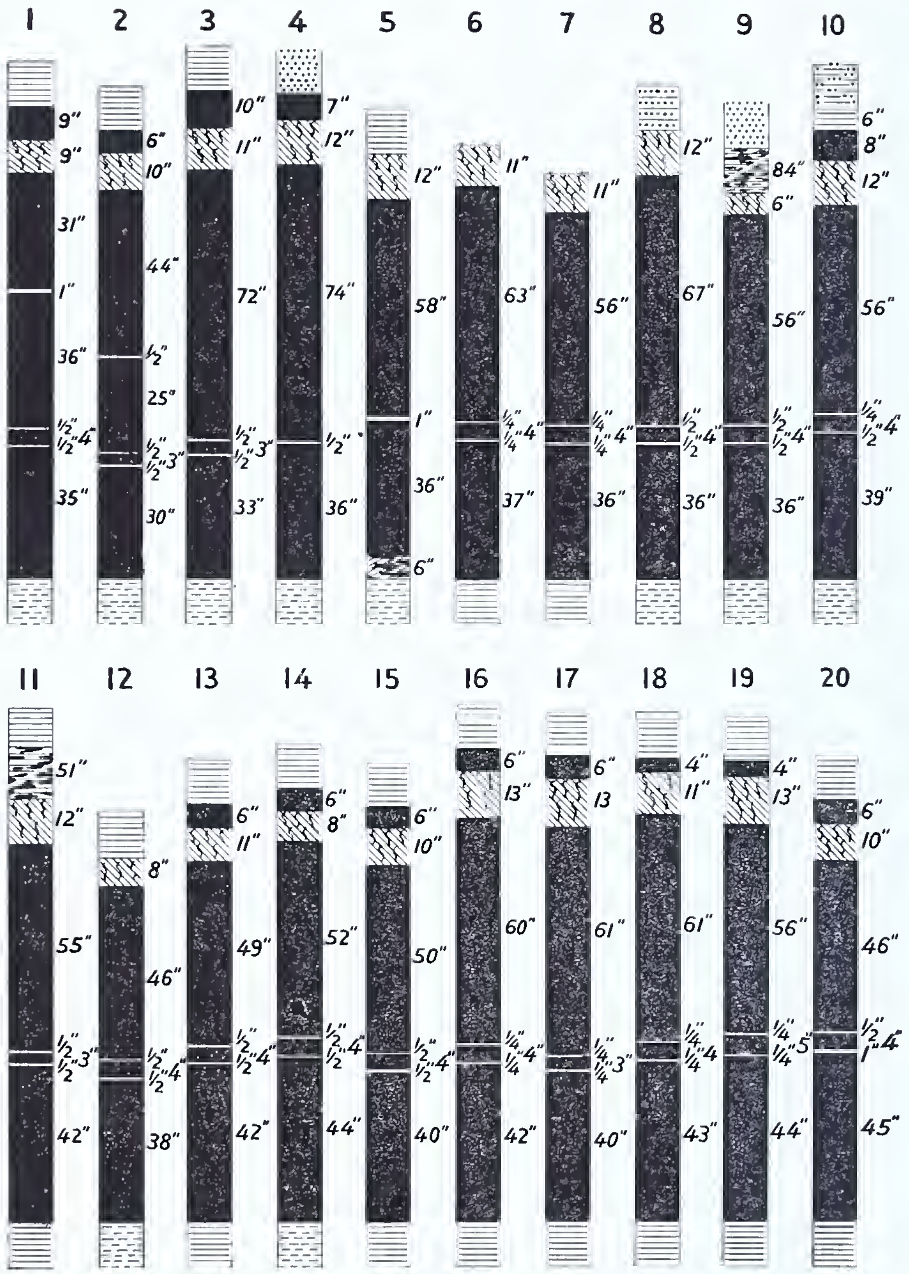

Figure 65. Sections of Pittsburgh coal in German and Menallen Townships.

Note: Letters and numbers designating location of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers of quadrilaterals from north to south; and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks, prospects or outcrops.

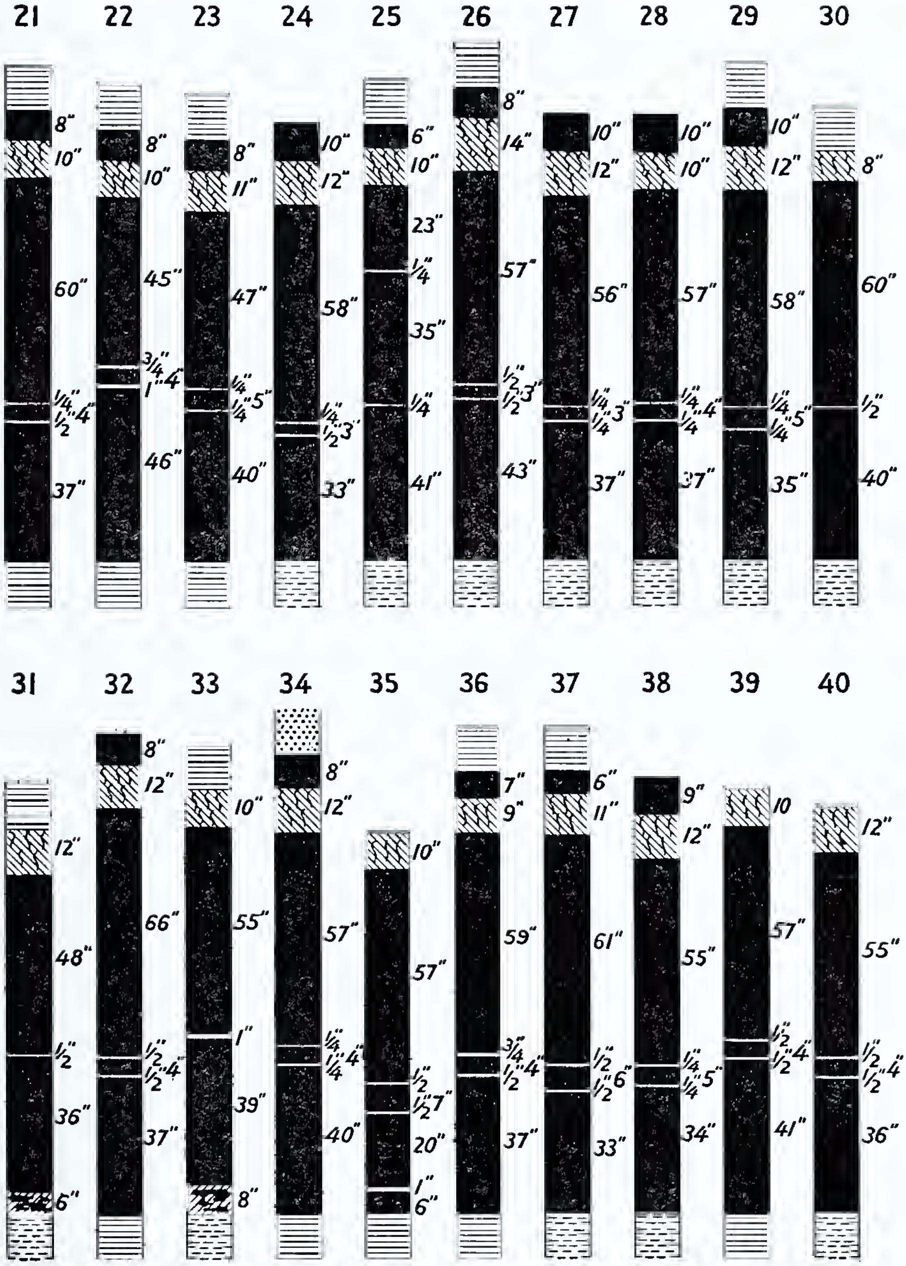

Figure 65. Sections of Pittsburgh coal in German and Menallen Townships.

1. Fe5, Edna mine. 2. Fe7, Lafayette mine. 3. Fe8, Lincoln mine. 4. Ef5, Searights mine. 5. Ef11, Dearth mine. 6. Ef12, Shamrock No. 1 mine. 7 Ef13, Shamrock No. 2 mine. 8. Fg3, Beal mine. 9. Fg4, Revere mine. 10. Eg4, Footedale mine. 11. Eg7, Elizabeth mine. 12. Eh1, Sapper mine. 13. Eh3, Peerless mine. 14. Dh1, League mine. 15. Dh2, Blaho mine. 16. Dh3, Leckrone No. 3 mine. 17. Dh5, Puritan No. 4 mine. 18. Dh6, Annamyra mine. 19. Dh7, Leckrone No. 2 mine. 20. Dh8, Emory mine. 21. Dh9, Leckrone No. 1 mine. 22. Dh10, Baker mine. 23. Dh11, Crawford mine. 24. Dg1, Lambert mine. 25. Dg4, Fretts mine. 26. Dg8, Puritan No. 3 mine. 27. Dg9, Puritan No. 6 mine. 28. Dg10, Old Home mine. 29. Dg12, Puritan No. 2 mine. 30. Df15, Buffington mine. 31. Cf14, Ralph mine. 32. Cg15, Edenborn mine. 33. Bg3, Palmer mine. 34. Bg5, Gates No. 2 mine. 35. Bg6, Gates No. 1 mine. 36. Ch6, Griffin No. 2 mine. 37. Ch9, Griffin No 3 mine. 38. Bh1, Ronco mine. 39. Bh3, Donald No. 4 mine. 40. Bh6, Donald No. 3 mine.

ALLEGHENY COALS

The only information available on the deeply buried Allegheny coals is a reported core section of the Upper Freeport coal from the gas well (Dg13) near Puritan. This Upper Freeport section from top to bottom consists of coal 6 inches, bone 4 inches, coal 26 inches, and black shale 12 inches. The bed is underlain by fire clay and overlain by sandstone.

CONEMAUGH COALS

Near Upper Middletown a coal correlated with the Bakerstown bed is mined for local use. An opening (Fe9) shows 35 inches of clean coal overlain by gray shale and sandy shale, and underlain by gray clay. This coal is believed to be approximately 185 feet above the top of the Upper Freeport bed and is the only Conemaugh coal observed or reported to attain mineable thickness in German and Menallen townships. A coal, believed to correlate with the Harlem bed, crops out (Fe10) on Route 51 near Upper Middletown. The section from top to bottom is bone 1 inch, coal 9½ inches, black shale 2 inches, clay 3 inches, coal 5 inches, and black shale 5 inches. This bed lies about 325 feet above the Upper Freeport coal.

MONONGAHELA COALS

The Monongahela formation contains several important coals in German and Menallen townships. The Pittsburgh bed is mined extensively and the Sewickley and Waynesburg beds have been mined commercially in the past.

Pittsburgh coal. The Pittsburgh coal at the base of the Monongahela formation is very regular in occurrence. It has been actively mined for many years in the area and the greater part of the coal has been removed. Normally, dark to gray shale forms the immediate roof of the Pittsburgh bed, although locally the Pittsburgh sandstone or sandy shale may directly overlie the coal as in the Footedale-Balsinger vicinity (Eg). The three major divisions of the Pittsburgh bed, the roof coal, main clay parting and lower or main division are present through the area, and form a total bed thickness of 8 to 15 feet. The roof coal or upper division ranges from a film to 84 inches thick and averages approximately 6 inches. It is present through the area except in the northwest corner of German Township, where locally it is missing. The coal is of poor quality, being somewhat bony and containing thin shale streaks. Unusual thicknesses of 4 to 7 feet were reported from the Revere (Fg4) and Elizabeth (Eg7) mines, where this division is composed of alternate beds of coal and black shale.

The main clay parting or draw slate is persistent and 6 to 14 inches thick, averaging 10 inches. In some of the mines, this division is reported to be locally absent. Generally the main clay parting breaks cleanly from both the roof coal and the lower division, but it may often be ''burned'' to either or both of the coals.

The lower or main division of the Pittsburgh bed ranges from 7½ to 9½ feet in thickness. It is subdivided into the breast coal from 49 to 74 inches thick at the top of the division, the bearing-in coal 3 to 8 inches thick and the bottom coal 30 to 46 inches thick. The brick coal is indistinct in this area and is considered part of the bottom coal. The breast coal is clean with only local shale or bone partings up to 1 inch thick. It is a somewhat general practice in the southern part of the area to leave the top 6 to 8 inches of the breast coal in place to support the roof. This upper portion of the bench, although of slightly inferior quality, is recovered in later mining. The bearing-in coal in these townships has the characteristic shale partings ¼ to 1 inch thick at its top and bottom. Very locally either of these partings may be absent. The bottom coal is generally clean and free of partings or binders. The basal 6 inches of this bench is dirty or bony in northern and northwestern German Township and is not mined in the Dearth (Ef11), Palmer (Bg3), Gates (Bg6) and Ralph (Cf14) mines. Elsewhere in the area the basal portion is of fair quality and is mined. Plastic gray clay which softens on exposure and gray to black shale form the floor of the Pittsburgh bed. Unusual features that affect the Pittsburgh coal locally are the peridotite porphyry dikes in the Gates mine and a sandstone "roll" in the Leckrone No. 2 mine (Dh7), which has a northwest course and entirely cuts out the coal for a width of 150 feet. Some mines in the south and southeastern parts of German Township contain occasional small clay veins from a few inches to 2 feet thick cutting through the coal. Generally, it may be said that the Pittsburgh coal of Menallen Township is more uniform and of slightly better quality than in German Township.

Pittsburgh Rider coal. The Pittsburgh Rider coal has a sporadic occurrence approximately 30 feet above the base of the Pittsburgh coal. It ranges up to 5 feet thick and where present it consists of interbedded coal and black shale of no commercial value.

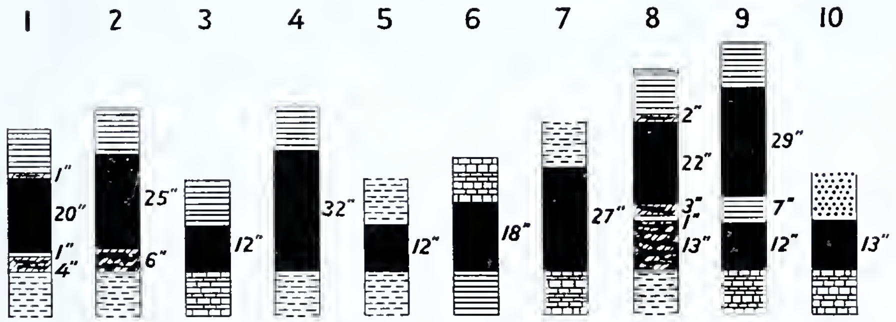

Figure 66. Sections of Redstone coal in German and Menallen Townships.

1. Ff1. 2. Dh4. 3. Dg1, Lambert shaft. 4. Df15, Buffington shaft. 5. Cg15, Edenbron shaft. 6. Bg4, Palmer air shaft. 7. Bg6, Gates No. 1 shaft. 8. Ch8. 9. Bh1, Ronco hoisting shaft. 10. Bh2, Ronco air shaft.

Redstone coal. The Redstone coal is persistent all through the area except in the vicinity of the Palmer shafts, where it is locally absent. It is from 1 to 4 feet thick, attaining the greater thickness along Cats Run in southern German Township. Where observed, it consists of two benches separated by ½ to 7 inches of shale. The upper bench is fairly clean, solid coal from 20 to 29 inches thick containing some knife edges of shale, and the bottom bench is from 4 to 13 inches of bony coal or bone. The shaft sections in German and Menallen townships show the Redstone coal as a single or double bed from 1 to 4 feet thick. This coal was formerly opened in a series of banks along Cats Run south of Masontown, where the thickness is reported to have been from 2 to 4 feet, and numerous clay veins and rolls were found affecting the coal. The bed generally has a drab shale or clay shale roof and is separated from the underlying Redstone limestone by 1 to 5 feet of gray plastic clay. The coal lies 50 to 85 feet above the base of the Pittsburgh coal.

Sewickley coal. The Sewickley coal lies 115 to 155 feet above the base of the Pittsburgh coal and is present all through German and Menallen townships, except the extreme northwest corner of German Township. North of Browns Run and North Branch, the coal in the Lambert syncline is thin and only very locally attains mineable thickness. South of these streams the bed is generally mineable and thickens from 2½ feet in the Ronco hoisting shaft (Bh1) to 6½ feet along the southern edge of German Township. Several commercial mines formerly operated around and west of Masontown, along Cats Run and the Monongahela River. In these mines the coal is from 5 to 6½ feet thick and consists of two benches. The upper bench, 39 to 49 inches thick, is separated from a lower bench 20 to 30 inches thick by 2 to 24 inches of bone or bony coal. Both benches contain local binders of bone or shale up to 5 inches thick and frequently the top several inches of the upper bench are bony coal. The lower bench contains harder and cleaner coal than the upper bench. In the ex-

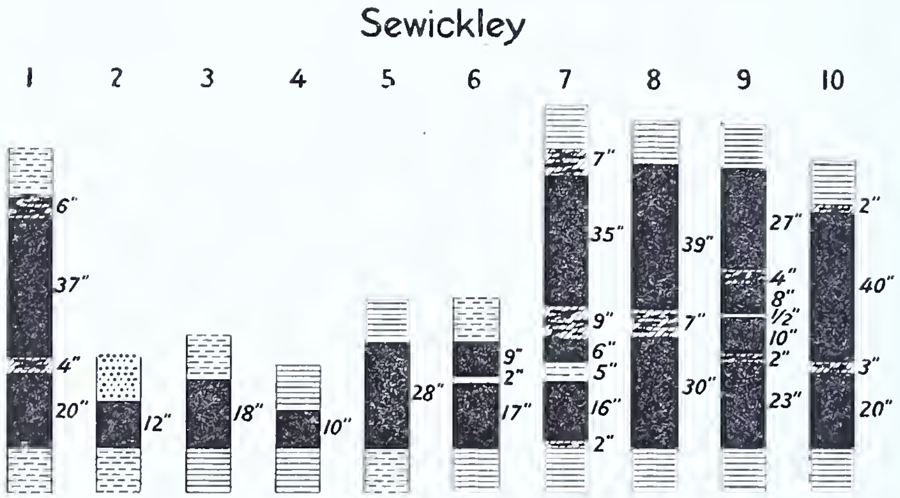

Figure 67. Sections of Sewickley coal in German and Menallen Townships.

1. Fg5, Playford mine. 2. Df15, Buffington shaft. 3. Cf14, Ralph hoisting shaft. 4. Cg15, Edenborn shaft. 5. Bh1, Ronco hoisting shaft. 6. Bg5, Gates No. 2 shaft. 7. Ch5. 8. Ch12, Rose No. 2 mine. 9. Ch14, Sterlin Sisters mine 10. Bh5, Stella No. 2 mine.

treme southeast corner of Menallen Township, the Playford mine (Fg5) is mining Sewickley coal in the Uniontown basin. This coal is 5 to 5½ feet thick, with 2 to 6 inches of bony coal at the top and 2 to 4 inches of coal and shale about 20 inches above the base of the bed. The roof of the Sewickley coal in the area is shale or clay shale with local sandy phases. The floor is usually dark shale, but gray plastic clay is fairly common.

Uniontown coal. The Uniontown coal lies 270 to 315 feet above the Pittsburgh coal. It is present locally and is reported 18 to 24 inches thick in several shaft sections northwest of McClellandtown (Dg). In a road cut (Ee8) west of the Lincoln mine, it is nearly 5 feet thick, but consists of four thin coal benches separated by clay partings.

Waynesburg coal. The Waynesburg coal is a persistent, easily recognized bed that lies 350 to 425 feet above the Pittsburgh coal. Its normal roof is gray shale or clay shale from 0 to 20 feet thick, which is, in turn, overlain by the coarse-grained, heavy-bedded Waynesburg sandstone. The sandstone locally rolls down, cutting out all or part of the underlying shale and coal. The Waynesburg coal usually consists of three coal benches separated by light to dark clay shale and clay partings of greatly varying thicknesses. The top bench from 9 to 19 inches thick contains dirty coal with numerous thin shale and bone partings, and in some places it is nearly a bone coal. The middle bench is separated from the upper by 1 to 12 inches of clay shale or shale and is from 18 to 31 inches thick. Frequently the top 1 to 5 inches of this bench are bony coal. A gray clay and clay shale parting, which ranges in short distances between 5 and 58 inches, separates the middle and bottom benches. The bottom bench from 24 to 36 inches thick often has a 1- to 2-inch layer of bony coal at the base and contains some pyrite balls and lenses. The coal of the lower two benches is bright and hard. The top bench is not mined, but is left to support the overlying shale, which usually slacks on exposure to air. The general floor of the coal is dark to black shale, although gray shale is occasionally found. The Waynesburg coal is present in the northwestern half of German Township and along the western edge of Menallen Township, and is believed to be of mineable thickness through this area. It is best developed along Middle Run, where it is 7 feet thick. Commercial mines have operated on the Waynesburg bed in this area, but it is to be remembered that the high mining costs and poor quality of this coal necessitate high prices for profitable operation.

PERMIAN COALS

The Permian coals are poorly exposed and measurable sections are scarce. From observed outcrops and reported sections, only the Waynesburg A, Washington and Jollytown coals attain mineable thickness. The other Permian coals appear to be thin, dirty and of irregular occurrence and have no value.

Waynesburg A coal. The Waynesburg A coal has numerous thick outcrops and is persistent through the area underlain by it in these townships. It was observed from 28 to 56 inches thick, containing numerous clay and shale partings from ½ to 7 inches thick. Parts of the bed are bony or bone coal. The roof of the coal is drab shale and the floor is clay and shale. The Waynesburg A bed lies approximately 60 feet above the top of the Waynesburg coal. It has no value in German and Menallen townships.

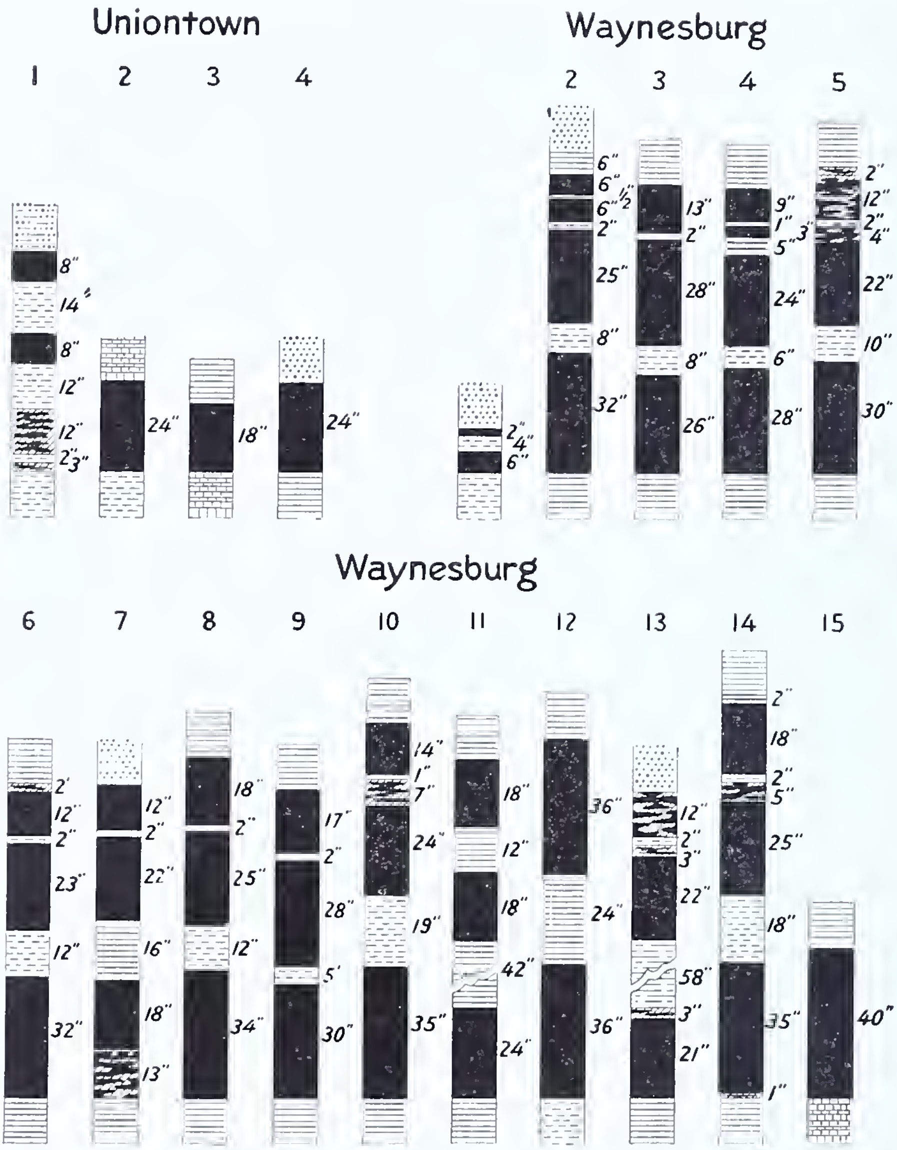

Figure 68. Sections of Uniontown and Waynesburg coals in German and Menallen Townships.

Uniontown coal: 1. Ee8. 2. Cg15, Edenborn shaft. 3. Cf15, Ralph air shaft. 4. Dg 1, Lambert shaft.

Waynesburg coal: 1. Ef6. 2. Ch2. 3. Ch3, Rush mine. 4. Cg3, Eliza mine. 5. Cg6, Harriet mine. 6. Cg10, Hartley mine. 7. Ch11, Sixth Pool mine 8. Cg12, Pross mine. 9. Cg14, Ida mine. 10. Cg17. 11. Cf15, Ralph air shaft. 12. Dg1, Lambert shaft. 13. Dg3. 1. Dg11. 15. Df15, Buffington shaft.
]

Washington coal. The Washington coal is 150 to 165 feet above the Waynesburg bed. It attains a thickness of 54 inches and consists generally of several coal benches separated by clay partings. The coal contains numerous thin shale and pyrite knife edges and has a very dirty appearance. The bed has a clay or shale roof and a clay floor. The Washington coal is persistent in the northwest part of German Township.

Jollytown coal. The Jollytown coal occurs only in the high hilltops near Dearthtown. It lies about 335 feet above the Waynesburg coal. Jollytown coal is persistent in outcrop and was observed 25 inches thick with a dirty upper half consisting of coal and black shale. The coal has no value.

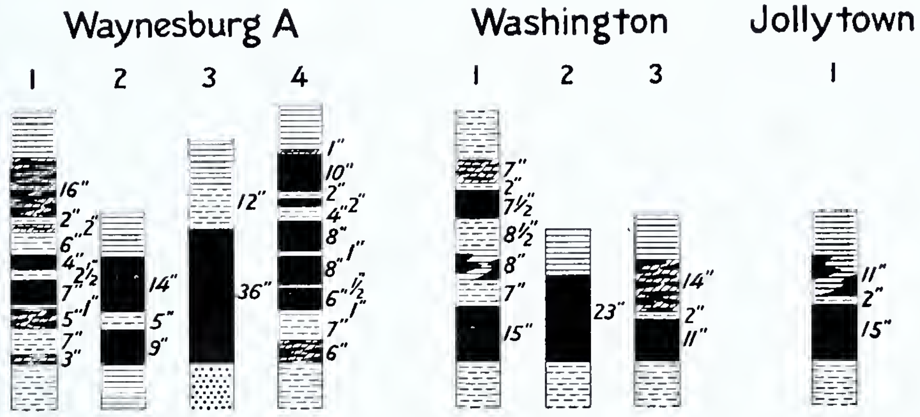

Figure 69. Sections of Washington coals in German and Menallen Townships.

Waynesburg A coal: 1. Ee9. 2. Cg2. 3. Cf15, Ralph air shaft. 4. Dg2.
Washington coal: 1. Cg1. 2. Cg7. 3. Df10.
Jollytown coal: 1. Df13.

Clay and shale

The outcropping clay and shale beds of German and Menallen townships have not been utilized, but many of them would probably be suitable for common brick manufacture. So far as is known, the draw slate or main clay parting of the Pittsburgh coal bed is the only bed of refractory nature exposed in the area. This parting in other localities has been used for low-heat duty refractories. Small deposits of clay in the Carmichaels formation may have value as pottery clays, or for other special uses.

Limestone

A few of the numerous limestones that crop out in German and Menallen townships have been quarried for agricultural lime. Some of the beds would be satisfactory for road metal, as shown by the physical analyses.

The Ewing (?) limestone of middle Conemaugh time is quarried for agricultural lime in an intermittently active quarry (Fe3) on the west side of the Uniontown-Pittsburgh highway half a mile north of Waltersburg. It is apparently a thin bed of gnarly, blue-gray, fresh-water limestone and contains some interbedded shale. This is the only Conemaugh limestone opened in the two townships.

The Redstone, Fishpot, Benwood, Uniontown and Waynesburg limestones of the Monongahela formation have been quarried in the area, chiefly for agricultural lime. In northern Menallen Township, the Redstone limestone was opened in several places. An active quarry (Fe2) half a mile north of Edna School exposes 5 feet of bluish limestone which was analyzed (F 140) physically and found satisfactory for all types of highway construction. An abandoned quarry (Fe6) just west of Edna School had about the same thickness of limestone. The Fishpot limestone was observed as an interbedded limestone and shale in an abandoned quarry (Ef14) half a mile east of New Salem. Two active quarries on the Benwood limestone are located (Fe11) on the hillside west of Smock and (Ef15) half a mile east of New Salem, near an abandoned quarry (Ef16) on the same bed. This limestone is suitable for agricultural lime and probably for highway construction. In the above quarries it consists of beds 2 to 5 feet thick of dark gray limestone separated by 1 to 3 feet of interbedded gray clay shale. The Uniontown limestone is from 6 to 10 feet thick in Menallen Township and is quarried from several openings (Ef7-8-9) ¼ and 1 mile north of Dearth. Chemical (F 27a-27b) and physical (F 27, F 15) analyses from the quarry just north of Dearth are given in the general discussion of the Uniontown limestone and show it to be suitable for agricultural lime and for all highway construction. A 10-foot outcrop (Ch1) of Waynesburg limestone ¾ mile east of Ronco was sampled (F 11) and found to be not suitable for highway construction.

The Upper Washington limestone is the only Permian limestone to be utilized in the area. An active quarry (Df12) one-quarter mile north of Lambert produces agricultural limestone.

Sandstone

Conemaugh and Permian sandstones have been utilized in German and Menallen townships for the construction of houses and coke ovens, and for road metal. The Morgantown and Connellsville sandstones of Conemaugh time were and are quarried through the central parts of the two townships. The Morgantown sandstone quarries are located at Fe4, Eg1, Eg2, and Dh12. They are all inactive. The quarry Fe4, half a mile west of Waltersburg, has a 35-foot face, which was sampled (F 16) and found unsuitable for highway construction. The Connellsville sandstone quarries are located at Eg3, Fg1, Eh2, Fg2, Eg5, Eg6, Dg6, and Dg7, of which the first three are active. In the quarry Eg3, one-quarter mile south of Stony Point School, an 18-foot face of gray, coarse-grained, medium- to heavy-bedded sandstone was sampled (F 73) and found unsuitable for highway construction.

The next higher sandstone quarried is the Waynesburg bed of Permian age. At present the quarries are inactive. They are located in western and northern German Township at Ch4, Bg2 and Df14. The only other Permian sandstone quarried is the Washington member. An active quarry (Df11) has a 10-foot face of brown, micaceous, cross-bedded sandstone which was sampled (F37) and found suitable for native stone base in road construction.

Oil and gas

Gas is produced along the Fayette anticline in its course through the eastern edge of German and Menallen townships. The Waltersburg, Haddenville, Fayette and Highhouse fields are producing from this axis. An isolated productive area, the Masontown field, in southwestern German Township, has produced considerable quantities of gas from the east flank of the Lambert syncline. More complete discussion of these fields will be found in the general oil and gas chapter.

The following driller's log of the W. W. Parshall well (Dg13) near Puritan is given because the well is reported to have been carefully drilled and measured, with cores taken of all the principal horizons.

Log of Parshall well near Puritan

Thickness (feet)	Character	
16	Sand and gravel	
50	White slate with limestone layers	
40	Dark shale and sandy shale	
50	Light sandy shale	
15	Limestone	
25	Light shale	
50	Sandstone (Little Dunkard)	
52	Dark slate and sandy shale	
60	Limy shales and slate	
215	Sandstone (Big Dunkard)	
½	Coal	(Upper Freeport)
1/3	Bone	
2-1/6	Coal	
1	Black slate	
14	Fire clay	
60	Dark slate	
10	Red shale	
100	Dark slate	
40	Sandstone	
100	Slate and sandy shales	
8	Coal and slate (Brookville-Clarion)	
100	Sandstone (Salt)	
25	Red shale	
10	Limestone (Little Lime)	
65	Black slate	
100	Limestone (Big Lime)	
200	Sandstone (Big Injun)	
125	Slate and sandy shale	
60	Sandstone (Squaw)	
100	Black slate	
110	Light slate with sandstone	
30	Sandstone	
40	Red rock	
10	Sandstone	
22	Dark slate	
50	Sandstone	
1½	Black slate	

NICHOLSON AND SPRINGHILL TOWNSHIPS

Nicholson and Springhill townships are discussed as a unit because of the similarity of structure and of outcropping rocks in each. These townships lie in the southwest corner of Fayette County. Springhill Township extends from the Monongahela River to the crest of Chestnut Ridge. Nicholson Township lies north of Springhill Township, their joint boundary line being Georges Creek.

The area is drained by the Monongahela and Cheat Rivers and their tributaries. The two rivers join at Point Marion (Ck) in southwest Springhill Township. Tributaries of the Monongahela River drain the northern and western parts of the townships. They are, beginning at the north, Cats Run, Jacobs Creek, Georges Creek, and Camp Run. The southeast corner is drained by Grassy and Rubles Runs, which have southwesterly courses and empty into Cheat River. From the flood plains of the Monongahela and Cheat Rivers, bluffs rise 300 to 400 feet to altitudes of 1,100 to 1,200 feet. An exception just southwest of New Geneva is the wide flat 100 to 200 feet above the river covered with Carmichaels deposits. The general level of the hilltops back from the river is from 1,150 to 1,220 feet altitude. This level persists to the foothills of Chestnut Ridge, where the rise is gradual at first and then steep to 2,600 feet altitude at the crest of the ridge. The crest marks the southeast boundary of Springhill Township. The flank of Chestnut Ridge is deeply notched by the upper reaches of Rubles Run. All the tributaries of the Monongahela and Cheat rivers flow through narrow, steep-sided valleys in their lower courses. The upper courses have relatively wider valleys with gently sloping sides.

Coal mining, beehive coke manufacturing and farming are the principal industries of Nicholson and Springhill townships. Sand and gravel for concrete aggregate and other purposes are dredged from the Monongahela River near Point Marion. A plant manufacturing various glass products is located in Point Marion. Railroads serving the two townships are the Monongahela Railroad with lines along Cats Run and the Monongahela River between Grays Landing and New Geneva, and the Baltimore & Ohio Railroad, with lines along the Monongahela River south of Point Marion, Cheat River, Grassy Run, and the upper reaches of Georges Creek and York Run.

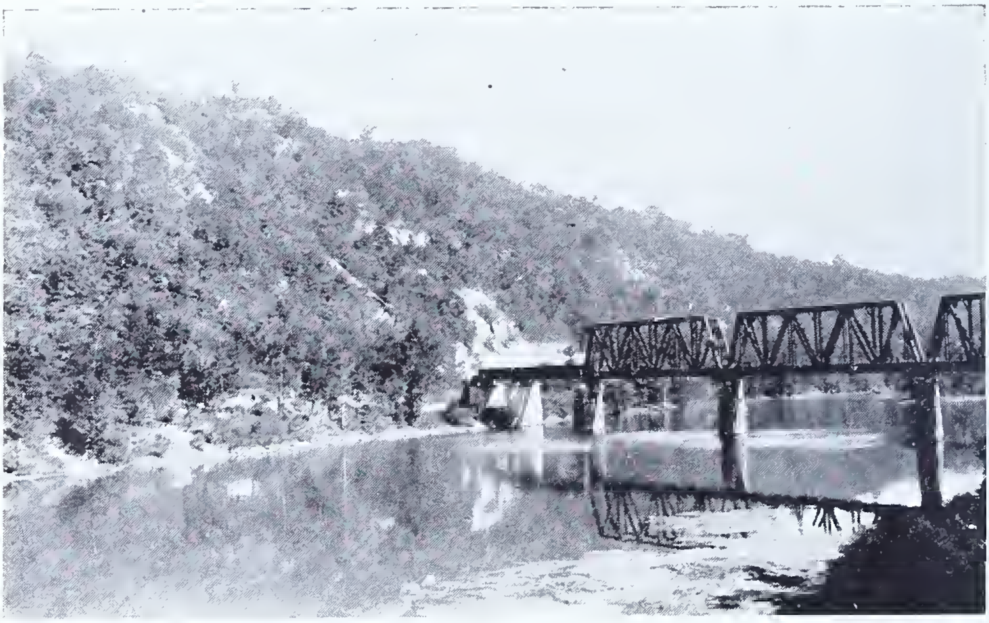

Figure 70. Bluff of Cheat River at Point Marion exposing Connellsville and Morgantown sandstones.

Structure

Nicholson Township and the western part of Springhill Township lie on the Fayette anticline. This anticlinal axis enters at the northeast corner of Nicholson Township, pursues a sinuous course toward and through Point Marion and leaves Springhill Township just north of the south boundary. It loses 115 feet in structural elevation towards the southwest. The low structural point in the two townships is at the northwest corner of Nicholson Township, where the Pittsburgh coal has an altitude of 800 feet. From this point, the strata rise 460 feet southeastward to the axis of the Fayette anticline at a maximum rate of 160 feet per mile. The strata on the southeast flank of this anticline dip gently 100 feet to the axis of the Uniontown syncline. This syncline has a wide bottom with gently rising flanks. Its axis is broken just southwest of Outcrop (Ej) and the structure is indistinct north from this point to the north corner of Springhill Township. South from Outcrop the syncline is canoe-shaped, falling 65 feet structurally to the Cheat River and then rising 25 feet to the south boundary line. The strata on the southeast flank of the Uniontown syncline rise gradually till 1 to 2 miles from the axis and then rise more and more steeply up the flank till near the axis of the Chestnut Ridge anticline which lies just east of the southeast corner of Springhill Township. The maximum rate of rise is about 360 feet per mile and the total difference in structural elevation between the Uniontown syncline and the Chestnut Ridge anticline is about 2,500 feet from Lake Lynn to the east corner of Springhill Township.

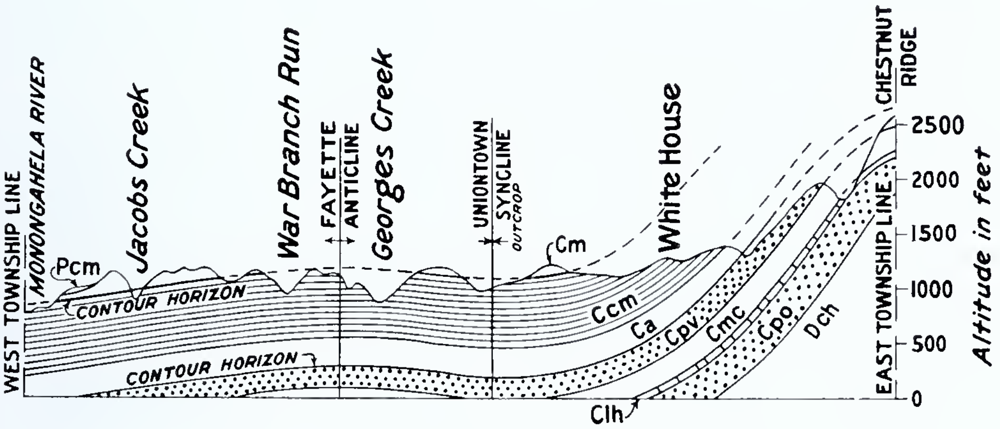

Figure 71. Structure section across Nicholson and Springhill Townships.

Legend: Pcm—Carmichaels deposits; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Cpo—Pocono series; Dch—Post-Chemung and Chemung formations.

On the structural geologic map, the structure contour lines in all of Nicholson Township and the western two-thirds of Springhill Township are on the base of the Pittsburgh coal bed. In the eastern third of Springhill Township, the structure contours are on the top of the Upper Freeport coal bed. The Pittsburgh coal lies 650 feet (average interval) above the Upper Freeport bed as shown in measured sections and gas well records. Hence the junction contour line of the two contour horizons may be either the Pittsburgh 1,300 or the Upper Freeport 650-foot contour. The junction contour is shown on the map as alternate dashes of each contour color and is labeled Pittsburgh 1,300—Upper Freeport 650.

Stratigraphy

Approximately 1,700 feet of consolidated strata crop out in Nicholson and Springhill townships. These sediments range in age from Pocono of early Mississippian time to upper Monongahela of Pennsylvanian time. Sediments older than Conemaugh time are exposed only on the west flank of Chestnut Ridge in southeast Springhill Township. Unconsolidated sediments are the Carmichaels deposits of Pleistocene age and sands and gravels of Recent age.

MISSISSIPPIAN

Pocono series. The upper 50 to 75 feet of the Pocono formation are exposed on the west flank of Chestnut Ridge in the heads of Rubles Run. From poor exposures, the top part of the formation is judged to consist of coarse-grained, light to buff sandstone in slabby beds.

Loyalhanna formation. The Loyalhanna formation shows its usual highly cross-bedded appearance where it crops out on the headwaters of Rubles Run along the Wymps Gap road in southeast Springhill Township. The formation is a fine- to medium-grained calcareous sandstone. It is generally gray in color, but local reddish irregular shaped bodies were observed in road cuts (Fk2, 3) northwest of Wymps Gap. A partial thickness of 40 feet was measured in this locality and the total thickness is believed to be between 50 and 60 feet.

Mauch Chunk formation. The Mauch Chunk formation crops out in the two deep notches cut into Chestnut Ridge by Rubles Run in southeast Springhill Township. The formation is believed to be 200 feet thick and is divided into parts by the Greenbrier limestone, which is well developed in the area. The upper and lower parts of the formation consist of red and green shales and green to drab micaceous, medium-bedded sandstone. These members are poorly exposed. The Greenbrier limestone lies just below the middle of the formation and consists of 15 to 20 feet of interbedded gray limestone and calcareous shale overlying 20 feet of massive blue-gray fossiliferous limestone.

PENNSYLVANIAN

Pottsville formation. The Pottsville formation is poorly exposed over a considerable area on the crest and west flank of Chestnut Ridge in southeast Springhill Township. It has an approximate thickness of 200 feet. No definite measurements were possible, as both the upper and lower contacts are concealed. The Connoquenessing sandstone or basal member was not observed in outcrop, but it is judged from float to be a buff to cream, coarse-grained sandstone with some beds of conglomerate. The Mercer member in the middle of the formation is a black to drab shale and sandy shale of indeterminate thickness. The Mercer coal is not exposed, but is probably present as a thin bed or series of beds. The Homewood or top member is a drab to light gray, coarse-grained sandstone. It is well exposed in the quarry (Ek4) just south of Springhill. Here the top 15 to 20 feet are thin-bedded and slabby, but the underlying 20 to 30 feet are heavy and massive-bedded. There is no conglomerate.

Allegheny formation. The Allegheny formation crops out in southeast Springhill Township in a ¼- to ¾-mile-wide strip bearing northeast and on the heavily wooded spurs of Chestnut Ridge. It is very poorly exposed and not much is known concerning its character. Float and occasional small outcrops indicate that the formation is dominantly drab to dark gray shale. Locally, the Kittanning and Westernport sandstones may be important. The Brookville-Clarion, Lower Kittanning and Upper Freeport coal beds were observed to crop out in several localities and they are believed to be persistent through the area. The Upper Freeport limestone was observed in some old workings (Fk1) southeast of White House. Along its outcrop, the Allegheny formation has the less-than-normal thickness of approximately 150 feet, which is comparable with other measurements to the north on the west flank of Chestnut Ridge. This subnormal thickness evidently persists along Chestnut Ridge in its entire course through Fayette County.

Conemaugh formation. The Conemaugh formation crops out over considerable area in the west three-quarters of Springhill Township and in the east half of Nicholson Township. In the west half of Nicholson Township, only the upper members of the formation crop out in the stream valleys, and at the mouth of Cats Run only the upper 40 feet are above drainage. The formation is 620 to 650 feet thick. It consists of sandy lower and upper parts separated by a shaly middle part. The Mahoning and Saltsburg sandstones are well developed and persistent in the eastern part of the area where they crop out. They are reported from well records to persist in the same character and development in the western part of the area. In the central and western parts of the area, the Morgantown and Connellsville sandstones are well developed members. The Connellsville sandstone forms cliffs along the Monongahela River and Georges Creek in the vicinity of New Geneva and Point Marion. Near Point Marion, the Morgantown sandstone is also well exposed near the base of the bluffs along the Monongahela and Cheat rivers. The few Conemaugh coal beds observed to crop out in the two townships are thin and not persistent. J. J. Stevenson reports the Bakerstown coal to be of good thickness near White House. Several Conemaugh limestones were observed. They are thin and impure. The middle shaly part of the formation is composed of a series of drab green and red shales lying between the Saltsburg and Morgantown sandstones. The Ames limestone in this interval was reported by Stevenson to crop out near White House.

Monongahela formation. The Monongahela formation crops out over large areas in the west two-thirds of Springhill Township and all of Nicholson Township as the capping strata in most of the hilltops. In the Uniontown syncline, through Springhill Township, these rocks form the top 30 to 150 feet of the highest hills. Along the Fayette anticline, the formation caps the hills in two general areas, one in northeast Nicholson Township and the other in west and southwest Springhill Township. On the east flank of the Lambert syncline, the Monongahela strata dip steadily westward until they are near drainage level in northwest Nicholson Township. The greatest thickness of this formation remaining uneroded in the area is about 340 feet in the hills southeast of the mouth of Cats Run.

The Pittsburgh coal at the base is persistent through the area except in southern Springhill Township, where the coal is locally cut out by the overlying Pittsburgh sandstone. This erosion period and resulting disconformity were general in southern Springhill Township and appear to have affected irregularly the basal 20 to 30 feet of the formation. Consequently, in this area, the intervals from the base of the Pittsburgh coal to the Redstone and Sewickley coals may be as much as 30 feet less than normal. The effects of this erosional disconformity are reported to have been observed in most of the mines on the Pittsburgh coal that lie within 2 miles of the southern boundary of Springhill Township. Areas affected range from a few inches to more than 800 feet in width. In some places only the upper part of the coal bed has been removed, but often the entire bed has been replaced by the sandstone. The contact between the coal and sandstone may be a steep or low angle and show many other variations, as illustrated by the small sketches on Figure T41. Usually the contacts are irregular, and coal streaks or thin coal lenses are commonly scattered through the replacing sandstone. Figure T41 shows an area near St. Johns Church (Dk) in which a large part of the coal has been affected. The figure is a rough reduction of the mine map in which the sandstone areas were definitely located by the mining operations to remove all available coal. The sandstone areas are not joined together and they vary considerably in size, having irregular outline. They do, however, have a general direction slightly north of west, with the long axes of the areas parallel to this direction. These sandstone areas are definitely a result of the local period of erosion that set in shortly after the deposition of the Pittsburgh coal in the area. Folding and warping played a minor role in the formation of these areas. Indications of folding are found in the Eagle mine (Dk8), where "domes" of coal from 12 to 25 feet thick and 25 to 50 feet in diameter border the south side of the major sandstone "cut-out" in this mine. The coal in these domes is reported to be almost free of impurities. At other points along the same border of the "cut-out" the coal is in two benches, each about 4 feet thick and separated by 2 to 10 feet of hard clay or clay shale.

The sandstone "cut-outs" appear to diminish in size and number to the west, although a "fault" 100 feet thick is reported in a mine just north of New Geneva. Clay veins up to 25 feet thick are reported to be fairly numerous in and around the area affected by the sandstone disconformity. They are no doubt closely associated with the occurrence of sandstone "cut-outs."

The quality of the Pittsburgh coal in southern Springhill Township is poorer than in any other areas of this bed in Fayette County. As the upper part of the bed contains more impurities than the lower, it is probable that the coal was deposited near the edge of a swamp which had a local movement westward while the coal material was being laid down. This movement reached its westerly limit just before the deposition of the Pittsburgh sandstone. When the movement attained its maximum, the Pittsburgh coal bed and immediately overlying shales were above water level and subjected to erosion on a long narrow peninsula (?) which extended west as far as, if not beyond, the Monongahela River. After a short period of erosion, the movement subsided and the Pittsburgh coal was again at water level. This was followed by the rapid deposition of the coarse-grained Pittsburgh sandstone which filled all erosion pits and channels, forming the present sandstone "cut-outs" or "faults."

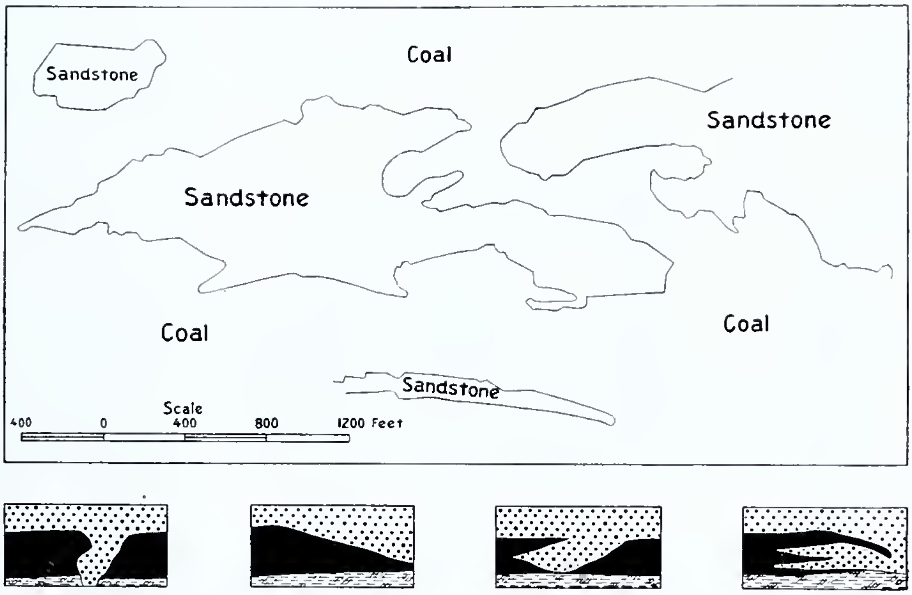

Figure 72. Plan and cross sections of sandstone "cut outs" or "faults" in the Pittsburgh coal in a mine in Springhill Township.

Above the erosional break at the base of the Pittsburgh sandstone, the strata have the usual occurrences and thicknesses. In normal section, the Pittsburgh coal is overlain by up to 15 feet (average 5 feet) of black to drab shales, which are in turn overlain by the Pittsburgh sandstone member. This sandstone is persistent and well developed in Nicholson and Springhill townships as a buff, medium- to coarse-grained slabby sandstone. It attains local thicknesses of 50 to 60 feet and forms cliffs in southern Springhill Township.

The Pittsburgh Rider coal occurring in the upper part of the Pittsburgh sandstone is thin, has a sporadic occurrence and is often represented by a black, highly carbonaceous shale. The Redstone limestone ranges from 5 to 25 feet in thickness and is persistent through the area. It is the usual gray to buff, dense, fresh-water limestone containing thin interbeds of gray limy shale. A thin bed of gray clay separates the Redstone limestone from the overlying Redstone coal. This coal is generally present in the area. The interval between the Redstone and Sewickley coal beds is occupied chiefly by shales and sandy shales with some irregular sandstone lenses. Near the top of the interval, the Fishpot limestone has a thin, sporadic occurrence. The Sewickley coal is a regular bed which has mineable thickness. The strata remaining uneroded above the Sewickley coal are poorly exposed. In this interval, the Sewickley sandstone and Benwood limestone appear to be well-developed members.

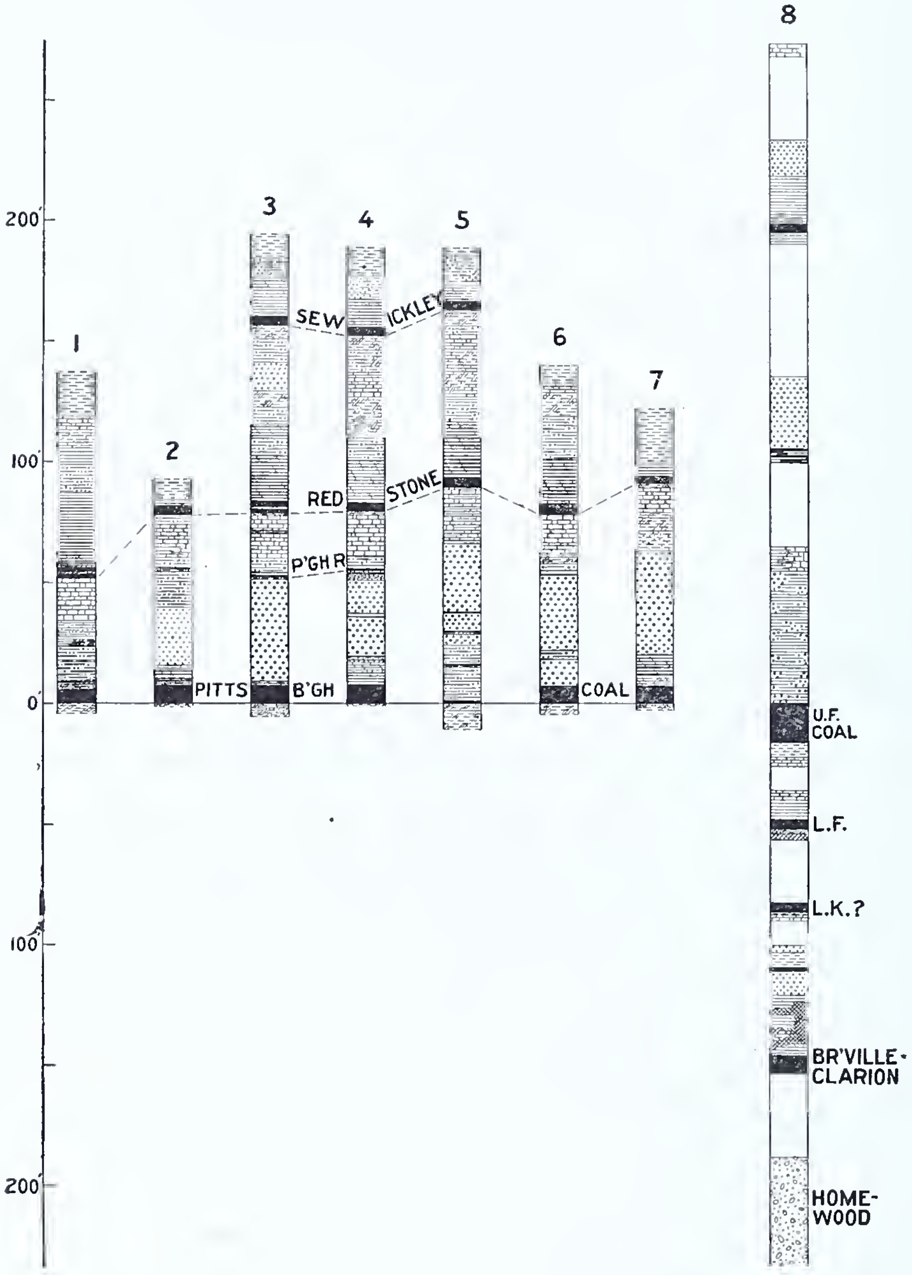

Figure 73. Stratigraphic sections in Nicholson and Springhill Townships.

1-7. Lower Monongahela formation in diamond drill holes (Dk1-7).
8. General section of Allegheny and lower Conemaugh formations in the vicinity of Spring Hill (Ek), Springhill Township, as measured by J. J. Stevenson; Penna. Second Geol. Survey, Report KK, p. 141. (Diamond drill hole records furnished by the Fancy Hill Coal Company.)

PLEISTOCENE

Carmichaels deposits. The Carmichaels deposits are unconsolidated sands, gravels, and clays of abandoned river channels. They occur in two areas of considerable size in Nicholson and Springhill townships. One just south of Cats Run extends more than 2 miles east from the mouth of the run, and the other, on the flat south and southwest of New Geneva, covers approximately 2 square miles. The bottom of these deposits lies 150 feet above and the top approximately 240 feet above the present river level. Their total thickness has never been ascertained, but in nearby Greene County, borings have proved thicknesses up to 80 feet. The deposits are dominantly sands and gravels, but locally fair thicknesses of clay are present. Small, isolated remnants of Carmichaels deposits occur in the vicinity of Point Marion along the Monongahela River.

RECENT

Alluvium. Alluvial deposits of sand and gravel form the narrow flood plains along the Monongahela and Cheat rivers.

Coal Resources

The Allegheny coal intervals listed below apply only to the region of outcrop of these coals along the west flank of Chestnut Ridge. They are based on a few observations and give only a very general average interval for the various coals. The intervals show that the abnormally thin Allegheny formation persists along Chestnut Ridge from the north to the south county line.

Allegheny coal intervals to the top of the Upper Freeport coal in Nicholson and Springhill Townships, in feet

Coal	Average
Upper Freeport	0
Lower Freeport	50
Lower Kittanning	110
Brookville-Clarion	155

Intervals are not given for the Conemaugh coals, as they are thin unimportant beds. Monongahela coal intervals are given only for the uneroded coals remaining in the townships.

Monongahela coal intervals to the base of the Pittsburgh coal in Nicholson and Springhill Townships, in feet

Coal	Average	Range
Sewickley	130	115 to 160
Redstone	65	40 to 90
Pittsburgh Rider	40	25 to 55
Pittsburgh	0	0

ALLEGHENY COALS

Information on the quality and thickness of the Allegheny coals in Nicholson and Springhill townships is very limited. The Upper Freeport and Lower Kittanning coals appear to be persistent and have mineable thickness. Available data indicate, however, that the quality of these coals is low. The Brookville-Clarion coal was observed only as a coal smut. One mile east of White House, the Lower Kittanning coal crops out (Fk) as a bed 3½ feet thick, showing, from top to bottom, shale, 20 inches coal, 1½ inches bone, 7 inches coal, 2 inches bone, 4 inches coal, ½ inch shale and 9 inches coal. A caved opening (Ek3) near Spring Hill indicates a mineable thickness for this coal. The Lower Kittanning coal is overlain by drab shale and underlain by clay. The Lower Freeport where observed in the field work for this report, is less than a foot thick. However, J. J. Stevenson (Report KK, p. 139) reports an opening near the junction of Wymps Gap and Drague Runs (Ek?). The section given shows 3 feet 10 inches of coal with a 3-inch and a 1-inch clay parting 11 and 17 inches respectively above the base of the bed. The coal is reported to be dirty and high in sulphur. Half a mile north of Spring Hill, the Upper Freeport coal crops out in a road cut (Ek2) and shows from top to bottom 2 inches bone, 11½ inches coal, 4 inches clay and 16 inches coal. The coal is dirty. It is overlain by drab shale and underlain by clay. Stevenson (Report KK, p. 138) reports the Upper Freeport coal near the junction of Wymps Gap and Drague Runs to be 16 feet 3 inches thick. The upper half of the bed is shale or clay containing thin coal layers. The lower half was mined and showed 20 inches coal, 10 inches dark clay, 24 inches coal, 18 inches hard clay, and 42 inches coal to the base of the bed. The basal bench was reported to have excellent quality, but the two upper benches were of inferior quality.

MONONGAHELA COALS

The Pittsburgh and Sewickley coals of the Monongahela formation have been mined extensively in Nicholson and Springhill townships. The Redstone coal is not thick enough to warrant commercial mining. At some localities it would be suitable for custom or house coal.

Pittsburgh coal. The Pittsburgh coal bed at the base of the Monongahela formation is the most important coal in Nicholson and Springhill townships. The coal is easily accessible, as its outcrop is above drainage throughout the area. Hence, a considerable part of the bed has been mined to exhaustion. The normal roof of the coal is black to drab shale up to 15 feet thick. However, this normal roof is persistent only in northwest Nicholson Township and north-central Springhill Township. Elsewhere, the well-developed overlying Pittsburgh sandstone cuts down and forms the immediate roof over large areas.

The roof coal or division is persistent except for cut-outs by the Pittsburgh sandstone. This division consists of dirty coal benches up to 3 feet thick separated by clay or black shale. It attains a maximum thickness of 10 feet, but is composed chiefly of shale and is valueless in the area. The main clay parting or draw slate of the Pittsburgh bed is persistent through all the area except the southern part of Springhill Township, where locally the roof division rests directly on the lower or main division. Where present, the main clay parting is from 4 to 16 inches thick and averages 8 inches.

In Nicholson Township, the lower or main division of the Pittsburgh bed is from 90 to 110 inches thick and is divisible into three of its components, the breast, bearing-in, and bottom benches. The breast bench from 40 to 55 inches thick is clean coal except for the top 6 to 8 inches which contain slate streaks and "sulphur" balls. Locally, a slate binder ½ inch thick appears near the middle of this bench. The bearing-in bench is from 4 to 7 inches thick. It has the usual make-up of two slate binders ¼ to 1 inch thick separated by 3 to 6 inches of coal. The bottom bench from 36 to 50 inches thick consists of clean coal except for the basal 4 to 8 inches which are usually bony. A local slate binder up to 1 inch thick occurs near or above the middle of the bench. This binder is the only clue to the further subdivision of the bottom bench into the brick and lower bottom benches which are recognized in northern Fayette County. Clay veins up to 20 feet thick are encountered in the mines in the southern and southwestern parts of Nicholson Township. A sandstone "fault" 100 feet thick is reported in a mine just north of New Geneva, and other mines nearby report local partial cut-outs of the Pittsburgh coal by the overlying Pittsburgh sandstone.

In Springhill Township the lower division of the Pittsburgh bed must be treated as a unit for its three benches are not recognizable. In this township the lower division is from 75 to 105 inches thick and consists of dirty coal in the upper part and fairly clean coal in the lower part. There may be as many as fifteen binders up to 3 inches thick scattered through this division. The binders are more frequent in the upper portion and are "burned" to the coal, making separation difficult. Frequently the top 12 to 18 inches of the lower division in this township are bone or bony coal. They are not mined, but left in place to form the roof. The basal 40 to 60 inches are generally fairly clean coal. The roof division often rests directly on the lower division, the main clay parting being absent. Clay veins are reported to be numerous in many of the mines in Springhill Township. Some are 25 feet thick. The sandstone "faults" previously described under stratigraphy affect considerable areas in the southern part of this township. In connection with these cut-outs ("faults"), one mine reports abnormal thicknesses of 12 to 25 feet of clean coal in a series of small domes bordering on one of the "faults." These thicknesses are evidently the result of the folding that played a minor role in the formation of the sandstone cut-outs.

The floor of the Pittsburgh coal in Nicholson and Springhill townships is gray clay about 3 feet thick. Locally dark to gray shale may form the floor.

Redstone coal. The Redstone coal is a persistent bed lying 40 to 90 feet above the base of the Pittsburgh coal. It generally is from 30 to 60 inches thick, but cannot be considered a commercial coal because of its poor quality. Its average thickness is greater in Springhill Township than in Nicholson Township. The bed is divided into two approximately equal benches by a black shale or bone parting from ¼ to 12 inches thick. The upper bench consists generally of an upper bony coal layer up to 8 inches thick and a lower layer of fairly clean coal. The lower bench consists of solid coal that is nearly a bony coal or bone. In south-central Springhill Township, this bench is locally a highly carbonaceous shale with many thin coal streaks. A clay vein

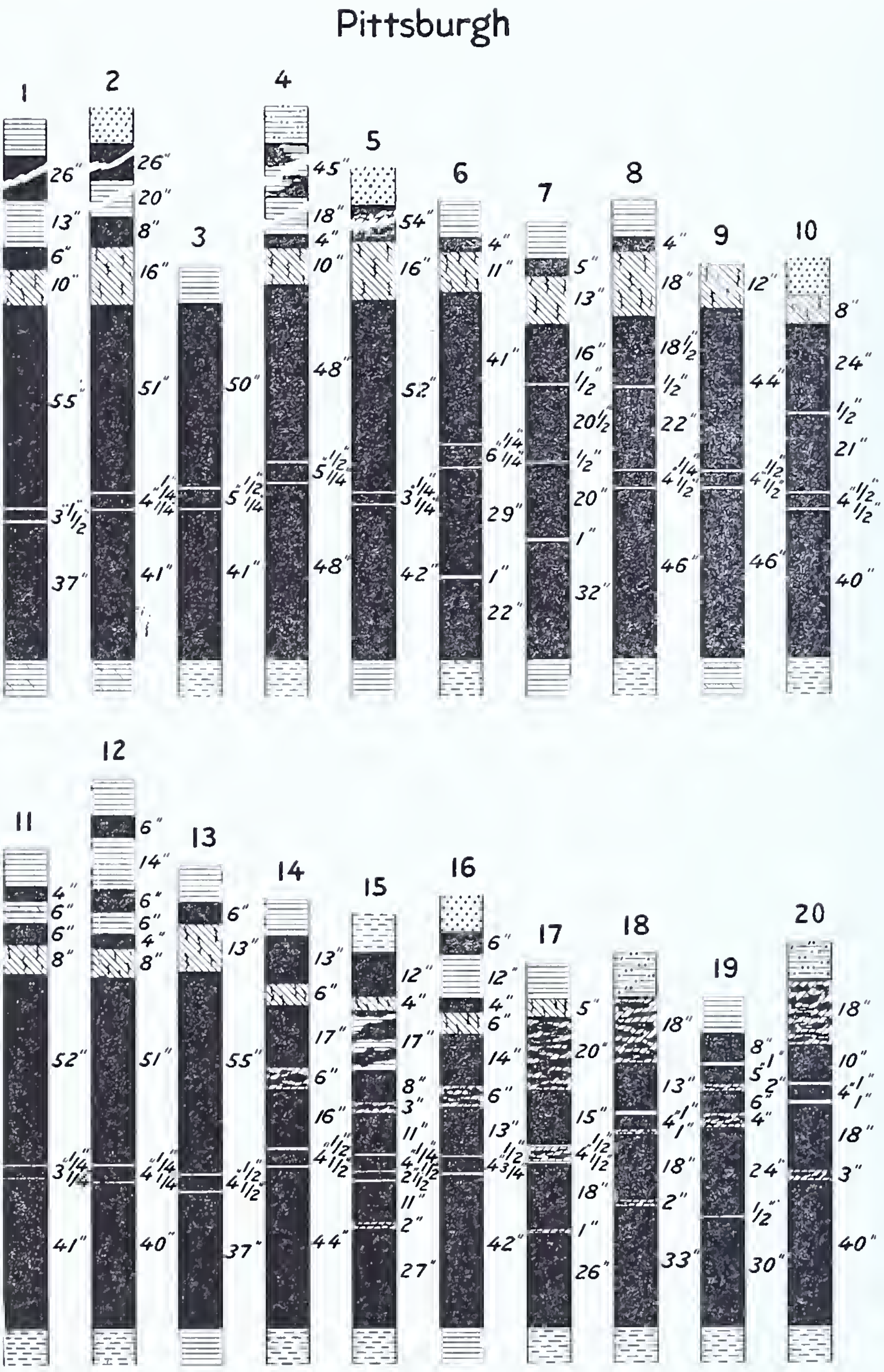

Figure 74. Sections of Pittsburgh coal in Nicholson and Springhill Townships.

(Note:—Letters and numbers designating locations of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers of quadrilaterals from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks, prospects or outcrops.)

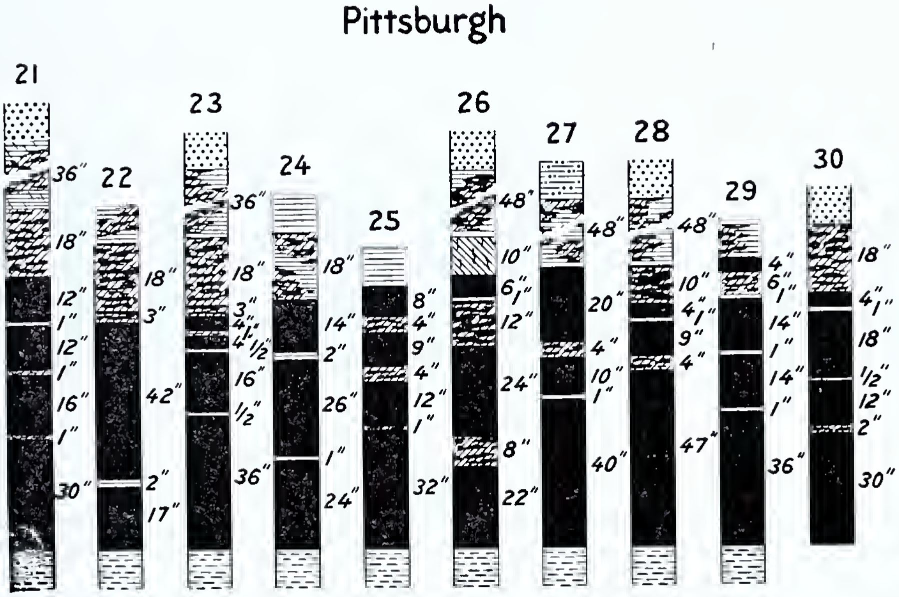

Figure 74. Sections of Pittsburgh coal in Nicholson and Springhill Townships.

1. Ch16, Griffin No. 1 mine. 2. Ch19, Leckrone No. 5 mine. 3. Dh15, Blue Rock No. 1 mine. 4. Di2, Leckrone stripping (north limb). 5. Di3, Leckrone stripping (south limb). 6. Di6, Bowood No. 2 mine. 7. Di12, Eddie mine. 8. Ci7, Martin mine. 9. Ci8, Geneva mine. 10. Ci10, Powell mine. 11. Bi1, Donald No. 1 mine. 12. Bi2, Donald No. 2 mine. 13. Bi4, American No. 3 mine. 14. Bj1, Winstead mine. 15. Cj2, Willa mine. 16. Cj4, Winstead mine. 17. Cj5, Atlantic mine. 18. Cj6, Locust Hill stripping. 19. Dj2, Baxter Ridge mine. 20. Dj3, Foster mine. 21. Ej3, Richhill mine. 22. Ej5, Sackett mine. 23. Ej6, Cornish mine. 24. Ek1, Crystal mine. 25. Dk8, Eagle mine. 26. Dk10, Marion mine. 27. Dk11, Ada mine. 28. Dk15, Freedom mine 29. Ck2. 30. Ck3, Frederick mine.

18 inches thick was observed in the country bank (Ci5) passing through the coal from bottom to top at an acute angle to the bedding and with irregular boundaries. The roof of the Redstone coal is gray shale or clay shale and the floor is gray plastic clay.

Sewickley coal. The Sewickley coal lies about 130 feet above the base of the Pittsburgh coal. It has a persistent mineable thickness averaging 60 inches in Nicholson and western Springhill townships, and 45 inches in central and southern Springhill Township. The bed section usually shows one or more shale or bone partings near the middle of the bed. At places the bed is free from any partings, though at others the central binder may be 6 inches of bone. Occasionally, the top 2 to 5 inches of the bed consists of bone or coal and shale. With the exception of these few impure portions, the remainder of the bed consists of bright clean coal. A few pyrite balls and streaks are scattered through the coal near the base of the bed. The roof of the coal is generally gray to drab shale, although locally it may be sandstone. The floor is gray clay or dark shale. The Sewickley coal has been extensively mined in Nicholson Township and much of the coal bed is exhausted.

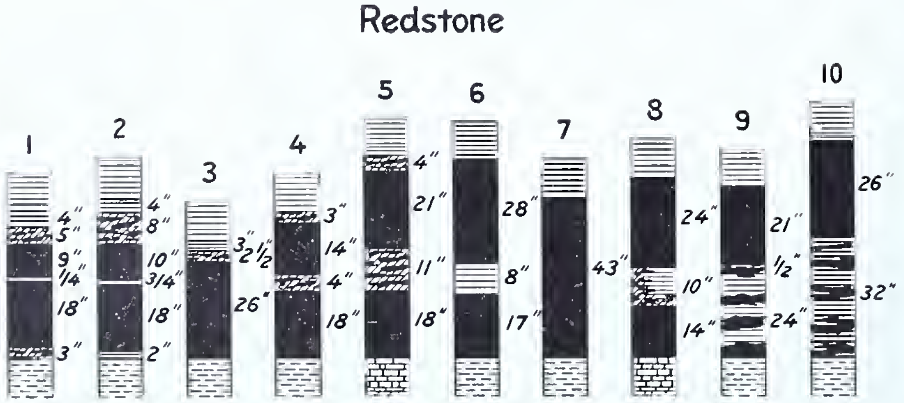

Figure 75. Sections of Redstone coal in Nicholson and Springhill Townships.

1. Di3, Leckrone stripping. 2. Di11. 3. Ci5. 4. Ci13. 5. Dk1, in diamond drill hole. 6. Dk3, in diamond drill hole. 7. Dk4, in diamond drill hole 8. Dk5, in diamond drill hole. 9. Dk16. 10. Dk17.

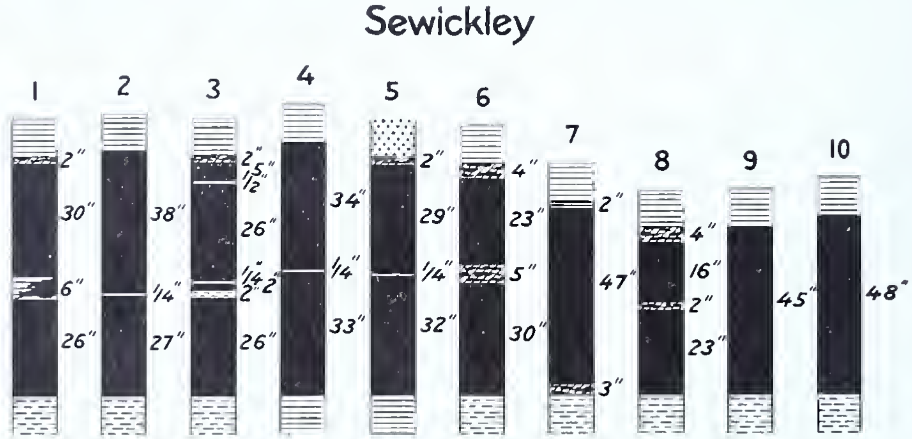

Figure 76. Sections of Sewickley coal in Nicholson and Springhill Townships.

1. Ch17, Klondike mine. 2. Ch20, Patrick No. 1 mine. 3. Ci3, Provins mine. 4. Ci4, American No. 4 mine. 5. Ci9, Stevenson mine. 6. Ci12. 7. Dj6. 8. Dj7. 9. Dk3, in diamond drill hole. 10. Dk4, in diamond drill hole.

Clay and shale

The clay and shale resources of Nicholson and Springhill townships are extensive, but little is known concerning their character. No data are available on any of the several fire clay beds that occur in the Pottsville, Allegheny and lower Conemaugh formations. The Mauch Chunk, Allegheny and Conemaugh formations contain thick shale beds that crop out extensively through the area. Many could probably be utilized for the manufacture of building brick. A red brick plant, long abandoned, was operated on the olive and bluff shales of upper Conemaugh age that crop out at the east end of the Cheat River bridge at Point Marion (Ck). In the same quarry a 4-foot buff clay bed was tested (Sample 92 in Clay and Shale chapter) and found suitable for drain tile or fireproofing. An upper Conemaugh shale that outcrops at the southwest edge of Point Marion was tested (Sample 93). It burns a uniform red color and would make satisfactory face brick and drain tile. A test (Sample 95) of the Upper Conemaugh shale outcropping along the railroad, just north of New Geneva (Cj), showed the shale to be suitable for common brick.

The large area of Carmichaels deposits on the flat south of New Geneva contains some irregular clay lenses that were worked on a small scale in the period from 1850 to 1900. The clay was very plastic with high green strength and was used for pottery, stoneware and roof tile manufacture. The results of tests, on a sample (No. 94) of somewhat sandy clay collected in a pit (Cj) ½ mile south of New Geneva, are given in the general clay and shale chapter.

Limestone

The limestone beds of Nicholson and Springhill townships have undergone little development. The Loyalhanna limestone crops out on the crest and slopes of Chestnut Ridge and is from 50 to 60 feet thick. It is a dense, impure, gray siliceous limestone that is suitable for all types of highway construction. Results of chemical analyses (F 108-109) on a sample collected from the road cut (Fk2) west of Wymps Gap are given in the general limestone chapter. Also listed are the results of physical tests (F 6) on 15 feet of the upper part of the formation which crop out (Fk3) west of Wymps Gap.

The Greenbrier limestone in these townships consists of an upper 15 to 20 feet of interbedded limestone and shale overlying 20 feet of heavy-bedded blue-gray fossiliferous limestone. This bed furnished good agricultural lime and is suitable for highway construction. Physical analysis results (F 5) on 10 feet of massive limestone, cropping out in the road (Fk4) west of Wymps Gap, are given in the general limestone discussion.

The Allegheny and Conemaugh limestones are generally thin and irregular in occurrence. Little is known of their character, but most of them could probably be utilized for agricultural lime and for certain types of road construction. Stevenson (Second Geological Survey, Report KK) reports the Johnstown, Upper Freeport and Mahoning limestones to be quite ferruginous.

The Redstone limestone from 4 to 15 feet thick consists of limestone beds separated by thin gray clay partings. It is generally of good purity and is satisfactory for agricultural lime. Physical tests (F 154) on a sample from a 4-foot outcrop (Dj5) near Morris Crossroads show the limestone to be suitable for highway material.

The Fishpot limestone is from 5 to 15 feet thick and is composed of massive beds of limestone 1 to 3 feet thick separated by thin gray shale beds. It is used for road and agricultural purposes. Northeast of New Geneva 7½ feet of limestone in a 10-foot exposure (Ci11) was sampled for physical analysis (F 8 in general limestone chapter). This limestone was used for flux in some of the old iron furnaces of the region.

Sandstone

Large quantities of sandstone are available in all sections of Nicholson and Springhill townships. The thick Pocono and Pottsville sandstones crop out on Chestnut Ridge and are probably suitable for building and road metal, as they are strong, durable and have good color. Sample F 7 in the general sandstone discussion was collected from 20 feet of Homewood sandstone in an abandoned quarry (Ek4) near Spring Hill. The Allegheny sandstones are not prominent and have little value. The lower Conemaugh sandstones have not been utilized, but the Morgantown and Connellsville sandstones of the upper Conemaugh have been widely developed in the western part of the area for building stone. Sample F 75 of 25 feet of massive brown Morgantown sandstone in a quarry (Dj2) along Georges Creek was unsatisfactory for road metal. The gray, heavy-bedded Connellsville sandstone has been opened in several quarries. It supplies good building stone and, as shown by sample F 9 of 25 feet of sandstone from quarry Dh14, it is suitable for road construction. The Pittsburgh sandstone of the Monongahela formation is a drab, heavy-bedded and coarse-grained bed of good thickness. It is easily accessible and should be suitable for building purposes.

Oil and gas

Gas is produced along the Fayette anticline in Nicholson and western Springhill townships from the Highhouse, Old Frame and New Geneva fields. These fields join each other and are part of the large Fayette field. The gas has been exhausted from the upper sands and, at present, production is obtained from the deeper sands down to the Speechley. Some production is obtained from the part of the Masontown field that lies in northwest Nicholson Township. This field lies well down the west flank of the Fayette anticline. More complete information on these fields is given in the general oil and gas discussion.

GEORGES TOWNSHIP

Georges Township in the southwestern part of the county extends 7 to 8 miles northwest from the crest of Chestnut Ridge, which is approximately the east boundary of the township. Its approximate center lies in map quadrilateral Fi.

The rugged west slopes of Chestnut Ridge occupy the eastern third of the township and are in decided contrast to the gently rolling countryside of the western two-thirds that lies in a partially dissected plateau. Georges Creek and its tributaries drain nearly all the area. The main stream rises in the mountainous section south of Oliphant and follows a southwest course through the township. It has many tributaries, the chief ones of which are Mountain Creek and Muddy Run. York Run, draining the western part of the township, is a tributary of Georges Creek, which it joins just outside the area. The South and North Forks of Browns Run and Coal Lick Run, a tributary of Redstone Creek, drain a small area in the northwest corner of the township. In the rolling, western section of the area, the streams flow through relatively wide, flat-bottomed valleys that have gently sloping sides. The rounded hilltops in the extreme western part of the township have altitudes between 1,200 and 1,350 feet. Eastward, the general altitude of the hilltops decreases to between 1,150 and 1,250 feet, reflecting the influence of the wide, main valley of Georges Creek. In the part of the area occupied by Chestnut Ridge, the streams all have steep gradients and run through narrow, steep-sided valleys. The slopes rise rapidly to the crest of the ridge, which has a remarkably flat but narrow top, with knobs that attain altitudes of 2,700 to 2,780 feet.

The portion of the township west of Georges Creek is served adequately by a good road system and by the Baltimore & Ohio Railroad, and the Pennsylvania Railroad, both having numerous branches and spurs to the coal mines. In the Chestnut Ridge area, roads are the only means of transportation. The principal industries of the township are coal mining, farming and the manufacture of explosives.

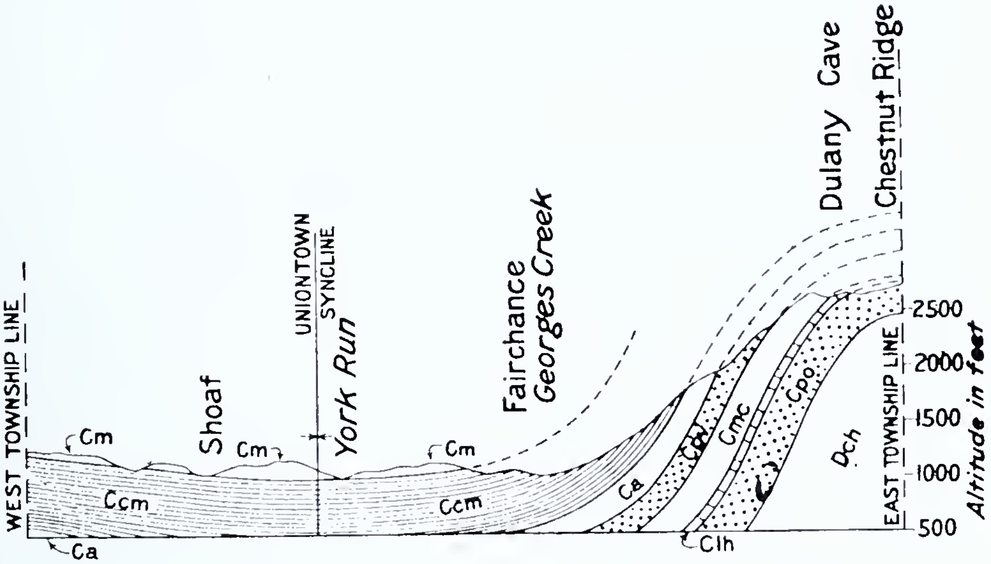

Figure 77. Structure section across Georges Township.

Legend: Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpo—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series; Dch—Post Chemung and Chemung formations.

Structure

Georges Township lies across the Uniontown syncline, with the eastern boundary corresponding roughly to the axis of the Chestnut Ridge anticline and the extreme southwest corner just touching the axis of the Fayette anticline. The axis of the Uniontown syncline pursues a southwestward course through the township, passing near Chadville (Gh), Collier (Fh), York Run (Fi), and Smithfield (Ei). From the north township line, the axis rises 350 feet in structural elevation in the 6 miles to Smithfield. South from Smithfield, the axis is practically flat to the south township boundary. The center of the syncline, as shown by the structure contours on the Pittsburgh coal, is shaped somewhat like the stern of a canoe. The west limb rising gently to the axis of the Fayette anticline has a maximum rate of rise of 175 feet per mile. East from the synclinal axis, the strata rise slowly in the first two miles and then more and more rapidly until within about 1½ miles of the axis of the Chestnut Ridge anticline. Here the inclination decreases rapidly to form a relatively broad crest for the anticline. The maximum rate of rise of the east limb of the syncline is about 1,000 feet per mile. Maximum amplitudes between the axis of the Uniontown syncline and the axes of the Fayette and Chestnut Ridge anticlines are respectively 500 and 3,250 feet. The axis of the Chestnut Ridge anticline, which roughly follows the east township line, loses about 400 feet in structural elevation from a high point in the northeast corner to the southeast township corner.

The underlying rock structure of the township is contoured on two datum planes, the base of the Pittsburgh coal (20-foot interval) in the western half, and the top of the Upper Freeport coal in the eastern half. The junction of the two horizons lies just west of the foothills of Chestnut Ridge and represents either the 1,300-foot contour on the Pittsburgh coal or the 650 contour on the Upper Freeport coal.

Stratigraphy

Consolidated strata that crop out in Georges Township range in age from post-Chemung time of Devonian age to Permian time of Carboniferous age. They comprise a total stratigraphic section of approximately 2,500 feet, with the older rocks exposed on the crest and in the deep stream notches on Chestnut Ridge, and the younger rocks exposed along the axis of the Uniontown syncline. Outcrops in the area are unsatisfactory, as only short and discontinuous stratigraphic sections are exposed. Consequently much of the following discussion on the character of the underlying strata was obtained from observations on float rock.

DEVONIAN

Chemung and post-Chemung strata. The upper Devonian strata are above drainage in the deep notches cut into the side of Chestnut Ridge by the headwaters of Georges Creek. Observations on its characteristics are limited to float rock, as the areas of outcrop lie near the head of the heavily-wooded hollows and outcrops of the strata in place were not found. From its float, the upper portion of the group is judged to consist chiefly of gray shale and sandy shale with some medium- to thin-bedded gray to drab sandstone. Approximately the upper 600 feet of this series is above drainage in the township.

MISSISSIPPIAN

Pocono series. The Pocono series crops out along the crest and nearly half way down the west flank of Chestnut Ridge before it passes below the surface. From scattered exposures and float rock, the series is composed almost entirely of massive- to medium-bedded, coarse-grained, white to gray sandstone. Some conglomerate boulders with pebbles up to ¾ inch were observed. The presence of minor amounts of shale and sandy shale in the series is indicated by the talus. The formation is believed to be from 300 to 350 feet thick in Georges Township.

Loyalhanna formation. This calcareous sandstone with a thickness of about 50 feet has a persistent, sinuous outcrop along the upper slopes of Chestnut Ridge. Near the middle of the eastern township line, it caps several small knobs on the crest of the ridge and in the southeast township corner; its outcrop is found on the sides of the high knobs. The formation shows the usual gray, dense, highly cross-bedded appearance. Dulany Cave (Gi) was formed by solution channels along the joint system of the formation where it lies under shallow cover for a relatively long distance on a spur near the crest of the ridge.

Mauch Chunk formation. Only general statements can be made concerning the make-up of the Mauch Chunk formation, which crops out in the middle slopes of Chestnut Ridge, except in the southeast township corner, where it caps the crest of the ridge. It has an approximate thickness of 200 feet and is divided into three parts by the marine Greenbrier limestone which lies 20 to 40 feet above the base. The Greenbrier limestone is from 25 to 40 feet thick, of which only the lower two-thirds is massive, blue-gray limestone. The upper third is composed of interbedded gray, limy shale and thin limestone beds. Below the Greenbrier member the basal section of the formation consists of red and green shale, and sandstone. It is more arenaceous than the upper member of the formation, which is composed of red and green shale with minor amounts of sandstone.

PENNSYLVANIAN

Pottsville formation. Exposures of the Pottsville formation in Georges Township are limited to cliff-like outcrops of the massive sandstones that are highly resistant to weathering. The formation crops out in a sinuous, relatively narrow belt along the middle and lower slopes of Chestnut Ridge. It caps many of the spurs between the deep valleys. The subdivisions of the formation were not recognized in detail in the field because of incomplete exposures, but they are no doubt present in much the same character as described in the discussions of North and South Union townships. From field studies in Georges Township, the formation may be broadly divided into a lower member (Connoquenessing) consisting chiefly of heavy-bedded, coarse-grained, gray to buff sandstone, a middle member (Mercer) of drab to black shale, and an upper member consisting of massive to heavy-bedded, coarse-grained to conglomeratic gray sandstone. The average total thickness of the formation in the area is estimated to be about 200 feet.

Allegheny formation. The Allegheny group of strata crop out in an irregularly shaped belt on the lower slopes of Chestnut Ridge. Information is fragmentary, but the formation is believed to have the same characteristics as in North and South Union and Springfield townships; that is, to consist chiefly of drab shale and sandy shale, and to have a subnormal thickness of about 160 feet along the steeply inclined outcrop. The Brookville-Clarion coal at the base of the formation is a persistent bed that is overlain either directly or after a short interval by a heavy-bedded, coarse-grained, gray to drab sandstone. This Clarion member extends nearly to the Lower Kittanning coal bed, which has a thin but regular occurrence. Above the Lower Kittanning coal, the interval to the Upper Freeport coal is dominantly drab shale and clay shale with some sandy shale. In this interval, the Westernport sandstone is generally present as a thin-bedded member. The Upper Freeport coal has an unusually thick development of 6 to 9 feet and is persistent through the area.

Conemaugh formation. The Conemaugh formation crops out in a mile-wide belt in the foothills of Chestnut Ridge northeast of Fairchance. This belt of outcrop widens rapidly southwest of Fairchance until, in the south-central and southwestern sections of the township, most of the outcropping strata are beds of this formation. Exposures are limited to short stratigraphic intervals and are discontinuous so that only general data are available on the formation. At the base, the Mahoning sandstone persists as heavy-bedded to massive, coarse-grained, gray sandstone that attains thicknesses greater than 75 feet. It is overlain by an interval consisting chiefly of drab shale which persists to the Saltsburg sandstone. This sandstone has a more or less regular occurrence. It is chiefly medium- to heavy-bedded, drab sandstone and is overlain by a shale and clay shale interval that contains appreciable thicknesses of red or variegated shales. The Morgantown and Connellsville members in the upper third of the formation are rather well developed through the township as thin- to heavy-bedded, drab sandstone. They are separated by a shale interval and the Connellsville sandstone is overlain by shale, limestone and clay to the Pittsburgh coal bed. The Conemaugh formation is estimated to be 625 to 660 feet thick in the area.

Monongahela formation. Strata of the Monongahela formation underlie a solid area in the north-central and northwest parts of the township. South, southwest and west of York Run, it caps only the hilltops and on approaching the township boundaries in these directions, the formation is found as isolated outliers completely surrounded by outcropping strata of Conemaugh age. The Pittsburgh coal at the base of the Monongahela formation is a persistent bed 9 to 16 feet thick. It is overlain directly or after a short interval by the Pittsburgh sandstone member, which may locally contain much shale and sandy shale. The Redstone limestone about 5 feet thick is overlain by the Redstone coal, which lies 55 to 80 feet above the base of the formation. Between the Redstone and Sewickley coal beds, the interval is chiefly drab to gray shale and sandy shale with a thin development of the Fishpot limestone which appears to be very ferruginous. The Sewickley coal lies 100 to 160 feet above the Pittsburgh coal and is overlain by the medium- to heavy-bedded Sewickley sandstone. The Benwood limestone occurs as thin to massive beds of fresh-water limestone interbedded with gray clay shale. Some sections of this member show 20 feet of limestone with no interbedded shale. Above the Benwood limestone the interval to the Waynesburg coal is occupied chiefly by sandstone with some shale and two or three thin limestone beds that may be correlated doubtfully with the Uniontown and Waynesburg limestone members. The Waynesburg coal at the top of the formation is persistent through its small area of outcrop as a thin bed. In Georges Township the total thickness of the Monongahela formation is found only in the north-central section where it is approximately 350 feet.

PERMIAN

Strata of Permian age crop out only in the north-central part of the township, where about 160 feet of the basal section remains uneroded in the hilltops. Exposures are lacking, but, as judged from float rock, these remaining beds consist chiefly of drab sandstone, sandy shale, and shale. The lower 50 to 75 feet, which corresponds to the Waynesburg sandstone, is dominantly arenaceous.

Coal resources

The important commercial coal beds of Georges Township are the Pittsburgh and Sewickley beds of the Monongahela formation. Other coals that attain mineable thicknesses in the area are the Brookville-Clarion, Lower Kittanning, and Upper Freeport beds of the Allegheny formation; and the Redstone and Waynesburg beds of the Monongahela formation. The Mercer, Upper Kittanning, Lower Freeport, Pittsburgh Rider and Uniontown coal beds are all more or less persistent, but were not observed or reported to be mineable at any place in the township. These thin coals will not be discussed.

The Allegheny coals crop out only in the foothills of Chestnut Ridge where the strata are dipping steeply and are poorly exposed. Consequently, definite intervals between the coal beds of the Allegheny formation could not be determined. Scattered observations indicate, however, that this formation is subnormally thin along its outcrop on Chestnut Ridge in Georges Township and that the thickness of the formation and the intervals between coal beds agree very closely with those given in the discussion of North and South Union townships.

Little is known of the Conemaugh coal beds. From scattered outcrops, it is apparent that none of them are mineable in this township. Permian coal beds, which underlie only a small area, are thin and sporadic in character.

The following table lists the intervals of the coal beds of the Monongahela formation from the base of the formation. The interval between the Pittsburgh and the Upper Freeport coals is about 650 feet.

Intervals of the Monongahela coals in Georges Township, in feet

Coal	Average	Range
Waynesburg (top)	350	345 to 355
Sewickley	130	100 to 160
Redstone	70	55 to 80
Pittsburgh (base)	0	0

ALLEGHENY COALS

The Allegheny coal beds are exposed only along the foothills of Chestnut Ridge where the Brookville-Clarion, Lower Kittanning and Upper Freeport have been mined for custom or house coal. They constitute an important reserve in Georges Township, although they occur relatively deeply buried in the western two-thirds of the area.

Brookville-Clarion or A coal. Several openings along its outcrop indicate a general mineable thickness of the Brookville-Clarion coal. Most of these openings have fallen in and the coal was seen in only two openings on the headwaters of the South Fork of Georges Creek near the south township boundary. Here the coal bed is from 50 to 80 inches thick and contains two persistent clay or shale partings. The upper parting just above the middle of the bed is 2 to 12 inches thick and the lower near the base of the bed is about 2 inches thick. Streaks and balls of pryite are rather numerous at some places. The bed is underlain by gray plastic clay and is generally overlain by drab shale which is displaced locally by the overlying, persistent Clarion sandstone.

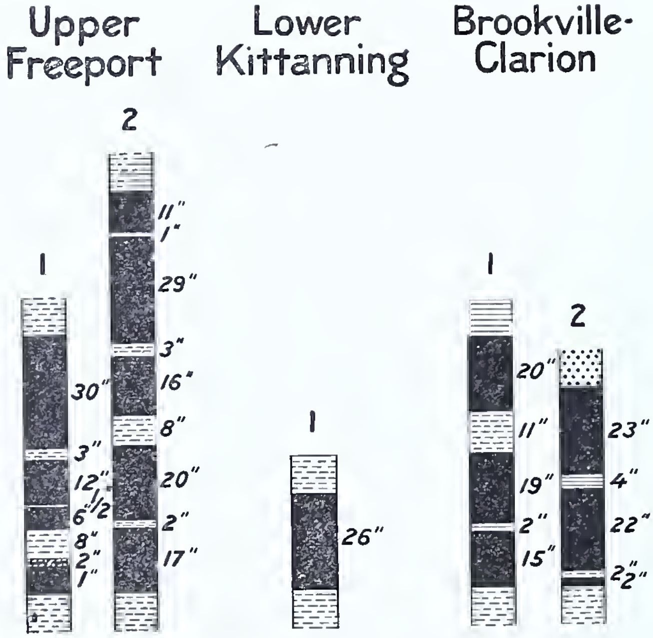

Figure 78. Sections of Allegheny coals in Georges Township.

Upper Freeport: 1. Gi2. 2. Gi2.
Lower Kittanning: 1. Gi3.
Brookville-Clarion: 1. Fj2. 2. Fj4.

Lower Kittanning or B coal. Data on the Lower Kittanning coal are scarce. It was observed only in the southeastern corner of the township, where it is composed of clean coal 26 inches thick. The bed is overlain by the usual dark to gray shale and is underlain by plastic clay.

Upper Freeport or E coal. The Upper Freeport bed in Georges Township maintains the unusual thicknesses observed in South Union Township. It was observed in Cave Hollow, where the total thickness is 5 feet, and in Lowe Hollow, where it is 8½ feet thick. The bed contains 3 or 4 partings of clay or shale spaced at rather regular intervals through the section. These partings are variable in thickness, ranging from ½ to 10 inches. Knife edges and lenses of pyrite are commonly found in the bed and are often plentiful in the top 6 to 10 inches. The Upper Freeport coal has a persistent occurrence along its line of outcrop and has been opened for custom coal at numerous localities. It is generally underlain and overlain by a gray clay or clay shale which softens after exposure to air. Clay veins are reported to cut through the coal at places. Locally, the overlying Mahoning sandstone cuts down and displaces the intervening shale and part of the coal bed.

MONONGAHELA COALS

The lower coals of the Monongahela formation crop out in the western half of Georges Township, but the upper beds are found only in the north-central section along the axis of the Uniontown-Connellsville syncline.

Pittsburgh coal. The important commercial Pittsburgh coal is persistent and regular throughout its area of occurrence in the western half of Georges Township. The total thickness of the three divisions of the Pittsburgh bed, the roof, main-clay and lower divisions, ranges from 8 to 15 feet. Dark to drab shale, sandy shale and sandstone immediately overlie the coal. The roof coal or upper division is persistent, although it may be replaced very locally in the southwest corner of the township by the overlying Pittsburgh sandstone. This division is composed of thin, alternating layers of dirty coal and black shale and although ranging from 1 to 6 feet thick, it has no value. The over-clay or main clay parting (locally known as ''draw slate'') separates the Pittsburgh bed into two benches. It has an average thickness of about 8 inches, varying between 2 and 14 inches, and is generally present. It is a detriment in mining, as it separates easily from the overlying roof coal, but tends to cling to the underlying main division. The main division, from 80 to 100 inches thick, contains the commercial coal of the bed and is remarkably clean and regular in occurrence through the area. It is readily subdivided from top to bottom into the breast coal, the bearing-in coal, and the bottom coal. The breast coal is from 40 to 60 inches thick and is commonly free from binders. Locally the ''penny-slate'' binder is found near the middle of this section. A few knife edges of shale and pyrite occur in the top 8 inches of the breast coal and this portion of the bed is frequently left in place during the first mining to support the draw slate. It is recovered in the second mining. The bearing-in coal, which is from 3 to 6 inches thick, shows the same characteristics wherever observed. It consists of a layer of coal from 2 to 5 inches thick, bounded on the top and bottom by shale binders. Each of these binders is burned to the coal on both sides and is ¼ to ¾ inch thick. The bottom coal is from 24 to 72 inches thick and does not contain any persistent binders. The upper half of this section has a blocky character and is somewhat harder than the lower half. These two halves would correspond respectively to the brick and lower bottom subdivisions of the main

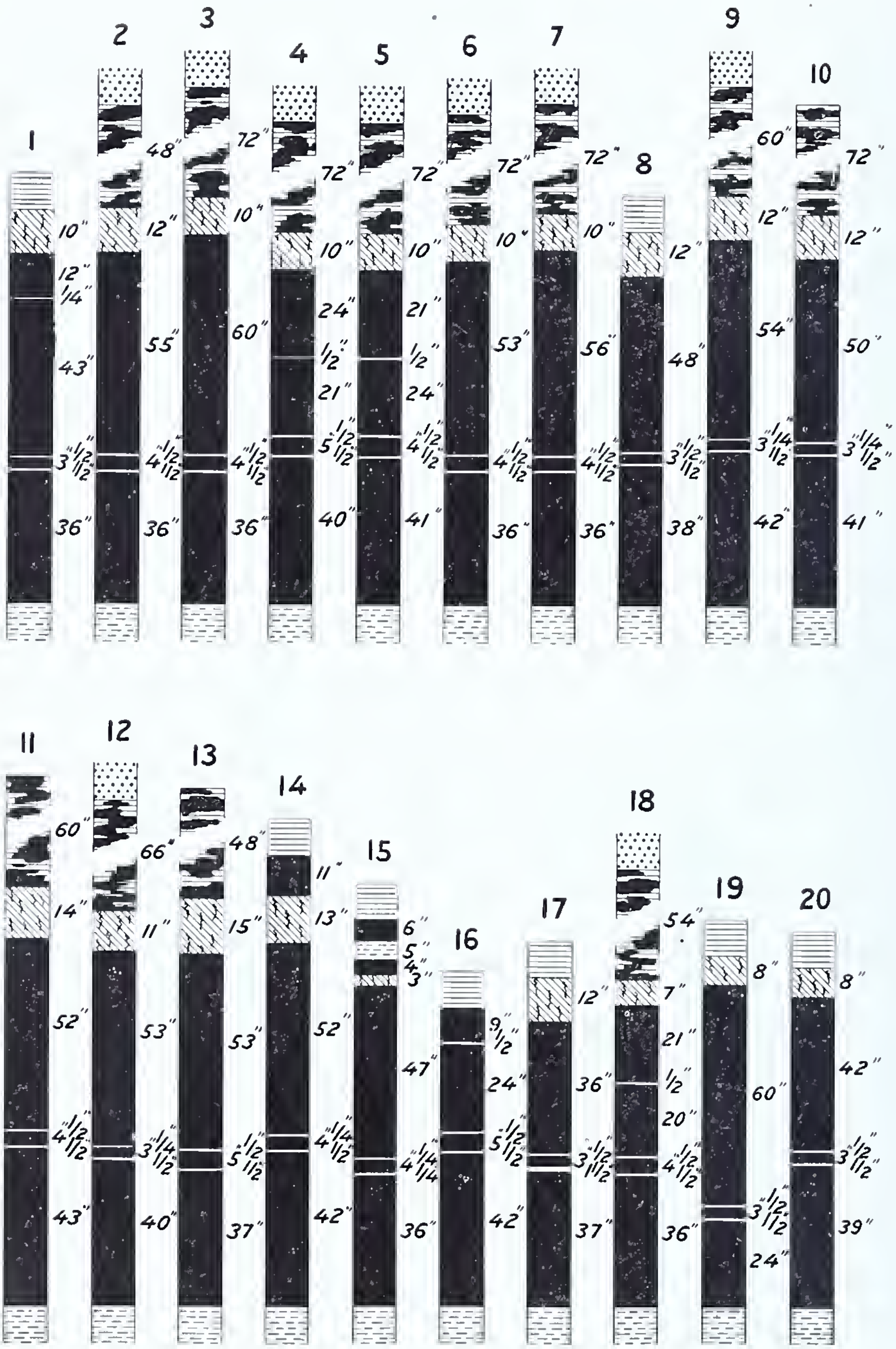

Figure 79. Sections of Pittsburgh coal in Georges Township.

1. Eg8, Newcomer mine. 2. Eg9, Continental No. 3 mine. 3. Fg6, Continental No. 2 mine. 4. Gh22, Oliphant mine (north side). 5. Gh22, Oliphant mine (south side). 6. Fh3, Collier mine. 7. Fh12, Wynn mine. 8. Eh4, Hayden mine. 9. Eh13, Shoaf No. 1 mine. 10. Eh15, York Run mine. 11. Eh16, Shoaf No. 2 mine. 12. Eh17, Thomas mine. 13. Eh18, Blue Rock No. 2 mine. 14. Ei3, Gilmore No. 1 mine. 15. Ei4, Martin mine. 16. Ei5, Russel mine. 17. Ej8, Lillian mine. 18. Fi3, Kyle mine. 19. Fi7, Daugherty mine. 20. Fi8, Dewberry mine.

division that are recognized in other regions. The floor of the Pittsburgh bed is gray plastic clay which contains thin beds and nodules of iron carbonate. In the past, this ore of iron was mined for use in the local iron furnaces.

The only irregularities observed or reported in the lower division of the Pittsburgh bed in Georges Township are a few thin clay veins that occur along the eastern outcrop near Oliphant. They cut vertically or nearly so through the entire thickness of the division and have a maximum thickness of 12 inches.

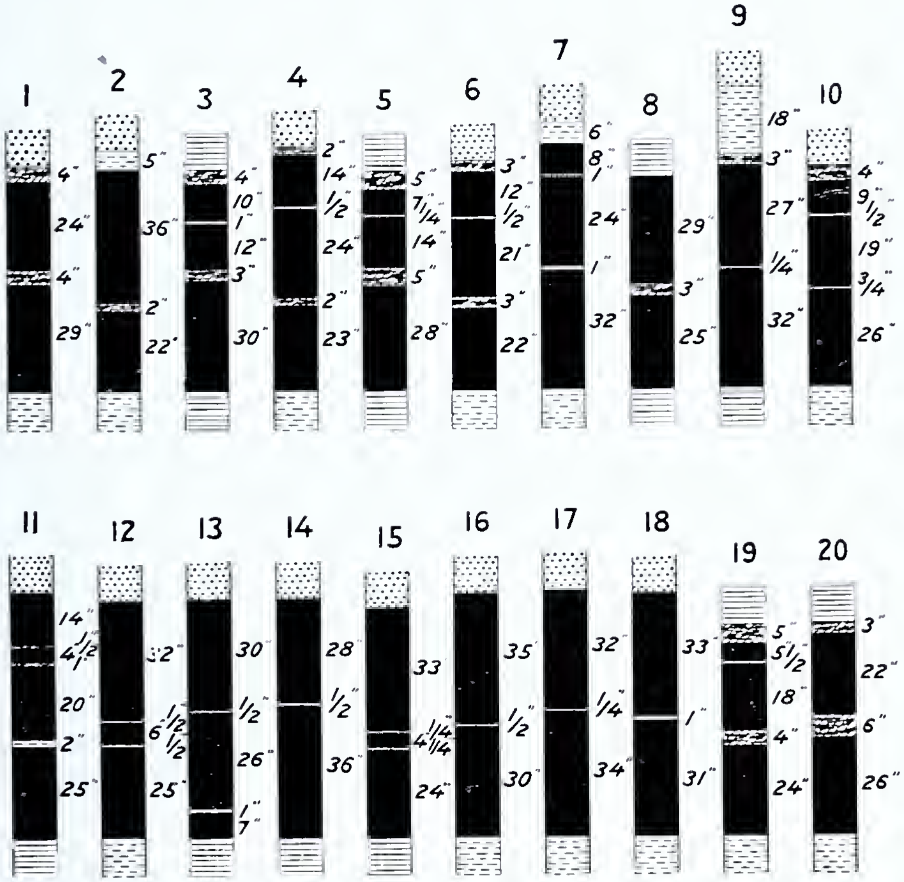

Figure 80. Sections of Sewickley coal in Georges Township.

1. Fg8, Hays mine. 2. Eg9, Amend No. 1 mine. 3. Gh6, Adams mine. 4. Gh7, Smiley mine. 5. Gh8, Jeffrey mine. 6. Hg9, Langhead mine. 7. Fh1, Irwin No. 11 mine. 8. Fh2. 9. Fh5, Shadyside mine. 10. Fh11, Deyarmon mine. 11. Eh5, Billie mine. 12. Eh6, Sapper No. 1 mine. 13. Eh8, Sapper No. 2 mine. 14. Eh9, Nellie mine. 15. Eh10, Love mine. 16. Eh11, Alice No. 1 mine. 17. Eh12, Hope mine. 18. Eh14. 19. Fi1, Shaw mine. 20. Fi5, Swaney mine

Redstone coal. The Redstone coal bed lies at an average interval of 70 feet above the base of the formation. It is a persistent bed through the area of occurrence, but apparently reaches mineable thickness only locally. A detailed section (Fh15) in a road cut north of York Run shows from top to bottom: drab shale, 1 inch black shale, 18 inches coal, 5 inches dark clay, 1 inch bone, 16 inches dirty coal, 18+ inches gray clay. Another section (Fi6) in a road cut west of

Fairchance shows from top to bottom: gray clay shale, 25½ inches coal, 3 inches clay, 3 inches coal, 17 inches black shale (cannel?), 18+ inches gray clay. These sections may represent unusual thicknesses, but they illustrate the general character of the bed in Georges Township.

Sewickley coal. The Sewickley coal bed lying about 130 feet above the base of the Pittsburgh coal has a regular and persistent occurrence in the area. It is between 50 and 80 inches thick and is split generally into two benches by a clay, shale, or bone parting near the middle. The upper bench from 24 to 40 inches thick is rather soft and dirty coal. Several non-persistent bone and shale binders occur in the upper portion of this bench, and the top 1 to 4 inches is frequently bone coal. Pyrite streaks and balls are fairly numerous. The bone or shale parting near the middle of the bed is from 1 to 8 inches thick and is hand sorted during mining operations. The lower bench contains harder and cleaner coal than the upper bench. It is 22 to 36 inches thick and is usually free from any binders. In normal sequences, the Sewickley coal is overlain by gray clay or shale that tends to soften after exposure to air, but in about half of its area of occurrence the immediate roof of the coal is the Sewickley sandstone. The bed is underlain by gray plastic clay which has numerous shallow rolls or "horsebacks." Clay veins up to 10 feet thick are found throughout the area and are reported to be more numerous near Oliphant and Fairchance. A "fault" more than 100 feet thick and having an easterly direction is reported in the Hays mine (Fg8), where it entirely displaces the coal bed. This "fault" was not observed, but it is believed to be an erosion channel filled in by the Sewickley sandstone. If so, it would be similar to those described in the discussion on Springfield Township.

Waynesburg coal. The Waynesburg coal occurs only in the high hills of north-central Georges Township near Chadville, where it lies about 350 feet above the base of the Pittsburgh coal. The Waynesburg coal was not observed during field work for this report, but several caved openings (Fh6, 7) southwest of Chadville indicate that it has a mineable thickness in the area.

Clay and shale

The clay and shale resources of Georges Township are not being developed at the present time and detailed information on them is scarce. On Chestnut Ridge, east of Fairchance, a 10-foot bed of clay was used formerly to manufacture face and fire brick. This bed is said to correlate with either the Mercer or one of the Allegheny clays. Physical tests on material from this operation are listed in the general chapter on clay and shale.

Limestone

The Loyalhanna and Greenbrier limestone beds which crop out along Chestnut Ridge have not been developed commercially in Georges Township. Stone for local use has been obtained from these beds from small pits. The Allegheny, Conemaugh and Permian limestone beds are thin and have not been opened. Limestones of the Monongahela formation have been worked rather widely in the past. The Fishpot and Benwood beds have been used for agricultural stone, road metal and flux stone for the old iron furnaces. At present, the Benwood limestone is quarried along the Morgantown Road (Fh8, 10) south of Chadville for road metal. Detailed descriptions and the results of physical and chemical tests on the limestone beds are given in the general chapter on limestone.

Sandstone

Little is known concerning the character of the sandstone resources of Georges Township except that they are large. It is plausible, however, that such beds as the Burgoon, Connoquenessing, Homewood, Clarion, Mahoning, Saltsburg, Morgantown and Connellsville sandstones would be sources of suitable material for uses for which these same beds are quarried elsewhere in the county. Small quarries or pits on these beds have furnished road metal and building stone for local use.

Oil and Gas

The only favorable rock structures for the occurrence of oil and gas in Georges Township are the Fayette anticline in the extreme western corner near Highhouse and the Chestnut Ridge anticline along the eastern boundary. South and southwest of Highhouse (Eh) wells have produced gas from the so-called shallow sands that lie above the Speechley horizon. These sands are not exceptionally large or prolific producers. On Chestnut Ridge anticline, relatively new production of gas has been obtained from the deep-lying Oriskany sand or a nearby horizon. This sand lies 6,500 to 7,000 feet below the crest of the ridge. Detailed descriptions of the two fields will be found in the general chapter on oil and gas, and the chapter on the Chestnut Ridge gas field.

NORTH AND SOUTH UNION TOWNSHIPS

North and South Union townships lie in the central part of the county and extend 6 to 7 miles northwest from the crest of Chestnut Ridge. The approximate center of the area is in map quadrilateral Hg. Uniontown, the county seat and the largest city in the county, is included in the discussion.

The western part of the area lies in the Kanawha section of the Appalachian Plateaus province, a mature, partially dissected upland, and the eastern part is in the foothills and slopes of Chestnut Ridge. Redstone Creek, rising in the northeast corner of South Union Township, follows a course slightly west of north through Uniontown to the northwest corner of North Union Township. Its tributaries draining the eastern part of the area are Lick, Benningtons, Spring, Cove and Rankin Runs. They rise on the slopes of Chestnut Ridge and have westerly courses. Coal Lick and Jennings Runs, the principal tributaries draining the western section, have northerly courses. On Chestnut Ridge the streams have narrow, steep-sided valleys, but after emerging from the rugged section, the valleys rapidly become wide and relatively flat. The valley sides rise gently in most places from these flat bottoms to a general level of flat-topped hills that have altitudes between 1,150 to 1,250 feet. On approaching the northwest corner of the area, Redstone Creek and the lower courses of its tributaries are slightly entrenched and the valley sides are steep. In the eastern third of the area the slopes rise rapidly to the crest of Chestnut Ridge. The knobs along the crest rise from 2,200 feet altitude in the northeast corner to 2,750 feet in the southeast corner of the area.

The principal mineral industries of the area are coal mining, beehive coke manufacture, and limestone quarrying. Transportation facilities are a network of improved roads and two railroads, the Baltimore & Ohio Railroad and the Pennsylvania System, which operate lines with numerous spurs.

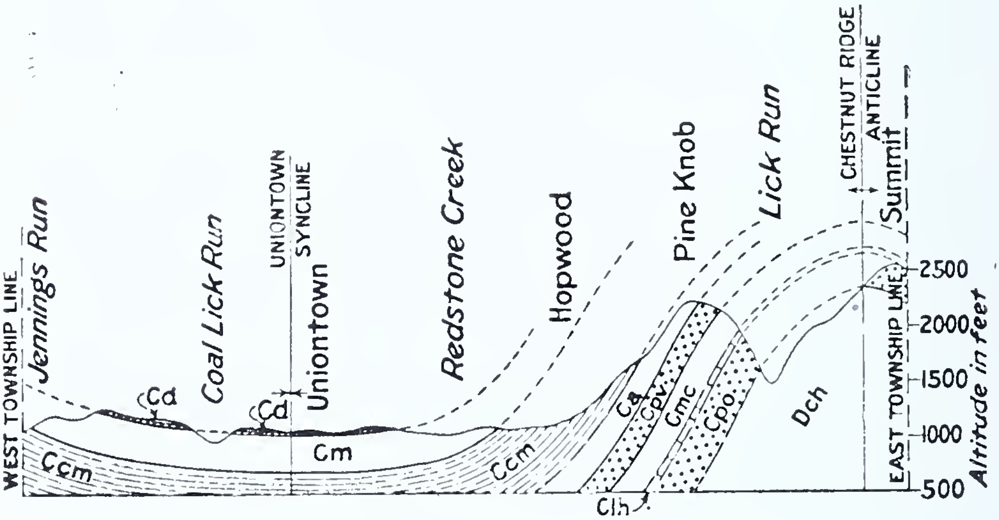

Figure 81. Structure section across North and South Union Townships.

Legend: Cd—Dunkard fromation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series; Dch—Post-Chemung and Chemung formations.

Structure

The underlying rock structure of North and South Union townships extends, in a southeast direction, from the upper part of the east flank of the Fayette anticline across the Uniontown syncline to the crest of the Chestnut Ridge anticline. The axis of the Uniontown syncline pursues a northeast course through Hatfield, Uniontown, and Oliver. The lowest structural point on this axis in Fayette County lies about one mile southeast of Bute (Hf), where the Pittsburgh coal has an altitude of about 505 feet. From this low point, the structure rises in all directions. Along the axis the increase in structural elevation is about 40 feet to the north boundary and 250 feet to the south boundary. West from the axis, the strata rise gently up the flank of the Fayette anticline for 1½ miles and then rapidly to the west boundary of the area at a maximum rate of 400 feet to the mile. On the east limb of the Uniontown syncline, the strata rise slowly in the first mile from the synclinal axis and then at a rapidly increasing rate to within 1½ miles of the axis of Chestnut Ridge anticline, where the rate of rise decreases and the strata become flatter as the anticlinal axis is approached. The maximum rate of rise on this limb of the syncline is about 2,200 feet per mile and the maximum amplitude between the axes of the Uniontown syncline and the Chestnut Ridge anticline is about 3,500 feet. The axis of the Chestnut Ridge anticline follows more or less closely the east boundary of the area. From a point (Jf) near the northeast corner, the axis rises about 1,000 feet southwestward to a high point at Summit (Ih). This high point persists to the southeast corner (Hi) of the area.

The lay of the strata of North and South Union townships is contoured on two datum planes, the base of the Pittsburgh coal (20-foot interval) in the west half of the area and the top of the Upper Freeport coal (50-foot interval) in the east half. The junction line of the two datum planes lies along the western foothills of Chestnut Ridge and represents either the 1,300-foot contour on the Pittsburgh coal or the 650-foot contour on the Upper Freeport coal bed.

Stratigraphy

The outcropping consolidated strata in North and South Union townships range in age from Chemung and post-Chemung period of Devonian time to the Dunkard period of Permian time. These exposed strata comprise a stratigraphic section of approximately 3,000 feet. Unconsolidated alluvial sediments of Recent age are found in the flood plains along Redstone Creek.

DEVONIAN

Chemung and post-Chemung strata. Strata of Upper Devonian age crop out in the notches or valleys cut into the west side of Chestnut Ridge by Shutes Run, Lick Run and the headwaters of Redstone Creek. In all these valleys, exposures are poor and talus usually conceals the underlying rocks. The only good exposure is along the National Pike between Turkeys Nest (Hh), which is midway up the mountain, and Summit (Ih), in which distance approximately the top 215 feet of the formation crop out. The exposed strata contain no red beds, but are dominantly gray to buff or brown sandstone with some interbedded shale. Near the top of the section, this shale contains fossils that were first found and discussed as Devonian fauna by Stevenson in his work for the Second Pennsylvania Geological Survey. The presence of these fossil remains, of which the identity was subsequently confirmed by several investigators in this section, is the principal reason for limiting the thickness of the Pocono series in Fayette County to 300-350 feet. Hence, all the exposed strata lying directly under the Pocono series in Fayette County are given the group name Chemung and post-Chemung. In North and South Union townships, the maximum exposed thickness of these Devonian rock is about 650 feet in the valley of Lick Run. The general lithologic relationship of the Pocono, Catskill and Chemung strata in Fayette and neighboring counties will be discussed under Henry Clay and Stewart townships.

MISSISSIPPIAN

Pocono series. The Pocono series has a continuous outcrop on Chestnut Ridge along the east boundary of North and South Union townships. South of Summit, it caps the mountain and extends well down the west flank before it goes below the surface. The series is composed almost entirely of gray to buff, coarse-grained sandstone which usually occurs in heavy to massive beds. Conglomeratic layers with quartz pebbles up to ¾ inch diameter are common. Minor amounts of interbedded shale and sandy shale are present. The basal 290 feet of the series is excellently exposed along the National Pike near Turkeys Nest. Although the total thickness of the Pocono, as limited by the Loyalhanna formation at the top and Devonian fauna at the base, is not exposed in these townships, it is believed to be between 300 and 350 feet with an average slightly less than 325 feet.

Loyalhanna formation. The Loyalhanna formation has an extensive outcrop on Chestnut Ridge in the eastern part of the area and an average thickness of approximately 50 feet. North from Summit, it is exposed near the crest and in the small valleys on the west side of Chestnut Ridge. South of Summit, the outcrop is about midway down the slope of the ridge. Typically, the formation is a gray, dense, homogeneous siliceous limestone that is highly cross-bedded. It is overlain by red Mauch Chunk shales and underlain by the arenaceous Pocono series.

Mauch Chunk formation. The Mauch Chunk formation in North Union Township has a rather extensive outcrop on the side and near the crest of Chestnut Ridge. South of the National Pike, its outcrop is limited by the unusually steep dips to a narrow belt well down the side of the ridge. The formation is divided into three parts by Greenbrier limestone that lies 20 to 40 feet above the base. The upper and lower parts consist chiefly of red and green shale with some green to brown, thin-bedded, micaceous sandstone. The Greenbrier member, from 20 to 30 feet thick, is composed of massive, blue-gray fossiliferous limestone from 15 to 25 feet thick at the base and interbedded limestone and shale at the top. Along the National Pike, the Greenbrier member and upper part of the formation are well exposed. The total thickness of the Mauch Chunk is not exposed in the area, but it is believed to be about 225 feet.

PENNSYLVANIAN

Pottsville formation. The Pottsville formation outcrop is a narrow, irregular belt on the lower slopes of Chestnut Ridge in most of the area and only in the northeast corner does the outcrop become wider and extend up the mountain to the crest. Good exposures are rare and the formation may generally be divided into but three members, Homewood at the top, Mercer in the middle and Connoquenessing at the base. In the exposure along the National Pike, near Hopwood, the formation is divided into five members only by stretching the imagination. In this exposure, the Connoquenessing member is 65 feet thick, of which the basal 35 feet is massive, coarse-grained gray sandstone and the upper 30 feet is dark to drab shale and sandy shale with some sandstone lenses. The shaly character of the upper part of this member is believed to be peculiar to the exposure, as fragmentary outcrops elsewhere in the area indicate a decidedly arenaceous composition for the whole Connoquenessing member. The Mercer member, composed chiefly of dark to carbonaceous shale, is about 50 feet thick and contains the Lower Mercer coal near the base. This probably represents a

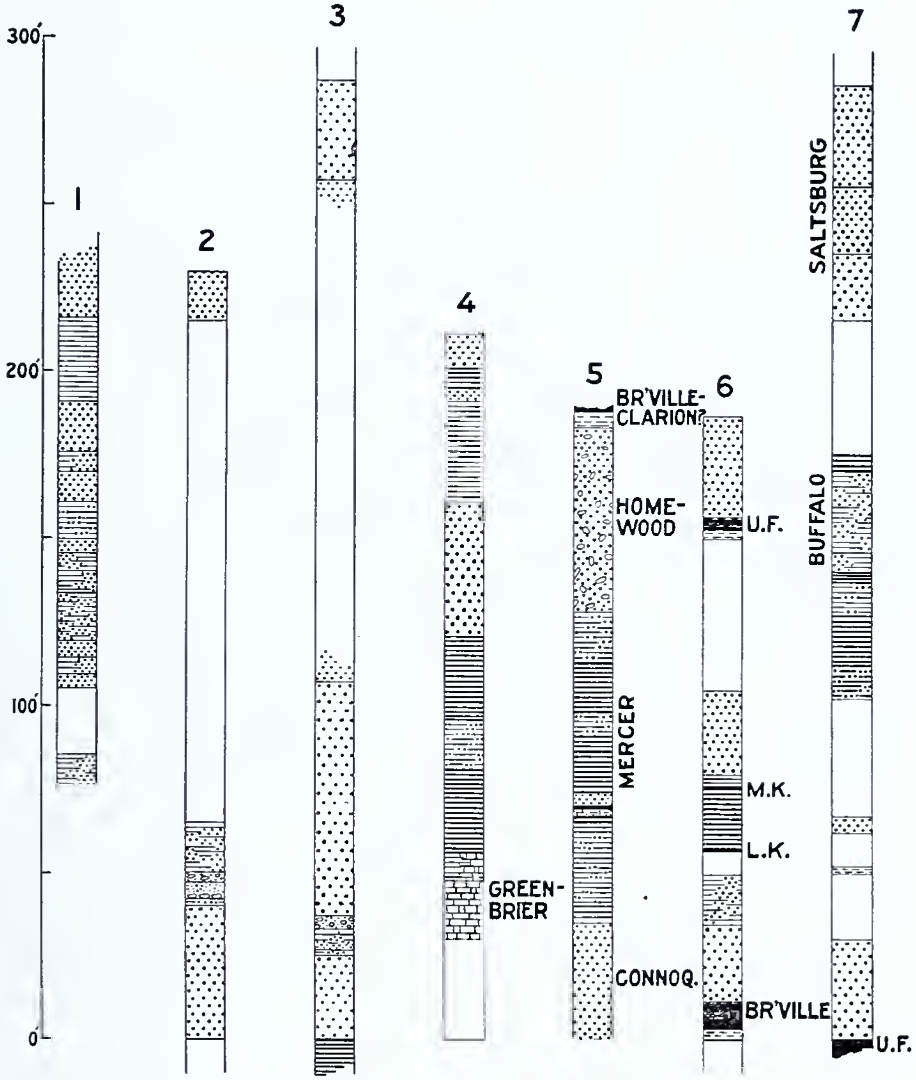

Figure 82. Stratigraphic sections in North and South Union Townships.

1. Devonian section near Turkeys Nest on Chestnut Ridge.
2. Devonian section near Summit on Chestnut Ridge. Top of section is estimated to be 150 feet below the base of Pocono series.
3. Pocono series near Turkeys Nest on Chestnut Ridge. This section is continuation of No. 1 section.
4. Section of Greenbrier limestone and upper part of Mauch Chunk formation near Hopwood.
5. Pottsville formation near Hopwood. This is a continuation of section No. 4.
6. Allegheny formation near Hopwood. This is a continuation of section No. 5.
7. Basal Conemaugh formation near Hopwood. This is a continuation of section No. 6.

maximum thickness of the Mercer in the area. Above the Mercer group, the strata to the Brookville-Clarion coal horizon are concealed in the immediate exposure except for 15 feet of drab sandy shale overlain by 5 feet of heavy-bedded, coarse-grained sandstone which directly overlie the Mercer. However, exposures in the near vicinity show this concealed interval, which represents approximately 50 feet of strata, to consist entirely of massive to heavy-bedded, coarse-grained, gray sandstone with some conglomerate lenses or beds. Through North and South Union townships, the average thickness of the Pottsville formation is about 200 feet.

Allegheny formation. Strata of the Allegheny formation are exposed in a narrow irregular belt that extends through the foothills of Chestnut Ridge from near the southeastern corner of South Union Township to the northeast corner of North Union Township, where the outcrop becomes wider and extends well up the slope of Chestnut Ridge. In this line of exposure, the strata are steeply inclined, the topography rugged and the vegetation usually dense; so that only poor exposures are found. Along the National Pike, near Hopwood, the best exposure shows the formation to be about 155 feet thick and to consist chiefly of dark to drab shale in the upper part and sandstone in the lower. This subnormal thickness fits the measurements and intervals obtained from sections of the formation at other localities on Chestnut Ridge in the county and is additional proof of a thin Allegheny formation in the area of Chestnut Ridge. As shown by drill holes elsewhere in the county, it is believed that the formation resumes its normal thickness to the west before the axis of the Uniontown syncline is reached. The character of the formation as exhibited in the exposure on the National Pike is representative of the usual make-up throughout the length of outcrop in the area. The Clarion and Westernport sandstones are persistent, heavy to massive-bedded, coarse-grained members. The remainder of the formation is shale and clay shale. Important coals are the Brookville-Clarion, Lower Kittanning and Upper Freeport.

Conemaugh formation. The Conemaugh formation extends through the middle of the area in a northeast direction in a belt that is ¾ to 2 miles wide. The eastern edge of the belt lies along the tops of the low foothills in the southern part of the area, but in the northern part it extends about half way up the slopes of Chestnut Ridge. Exposures are poor and usually show only short stratigraphic intervals. Prominent sandstone members persistent through the area are the Mahoning, Saltsburg, Morgantown and Connellsville. They are usually heavy-bedded, coarse-grained buff to gray sandstones. The remaining two-thirds of the formation is dominantly shale with some sandy shale and shaly sandstone. These shales are commonly gray to drab and dark in color, but near the middle of the formation red and green shales are abundant. None of the Conemaugh coals were observed to have commercial thickness in the area. The total thickness of the formation was not obtainable in the area, but it is believed to be approximately the same as in surrounding townships or about 640 feet.

Monongahela formation. Strata of the Monongahela formation occupy two belts, one along the western edge of the area and the other extending in a northeast direction through the middle. South of Oliver (Gf) the upper part of the formation crops out in the stream valleys across the Uniontown syncline so that the two belts mentioned above are connected. The Pittsburgh coal bed at the base is a persistent member from 9 to 16 feet thick that is overlain by 60 to 70 feet of drab to dark shale, sandy shale, and sandstone. The Pittsburgh Rider coal was not observed in the field and is reported only in the Leith shaft, where it is 50 feet above the Pittsburgh coal and directly overlies an unusual occurrence of limestone that was not observed in the field work in the Uniontown basin. Above the shaly interval the persistent Redstone limestone from 9 to 14 feet thick is separated by a thin layer of clay from the regularly occurring Redstone coal bed. This coal is generally overlain by 20 to 35 feet of gray clay shale and shale which is in turn overlain by a fair development of the Fishpot limestone from 10 to 25 feet thick. The Sewickley coal lying above the Fishpot member occurs in the northern and central parts of the Uniontown syncline in this area as a double or triple split bed of which the upper and lower splits may be separated by as much as 30 feet of sandstone and sandy shale. Progressing towards the southern boundary of the area, the interval between the Upper and Lower Sewickley coals becomes smaller and the two coals are believed to merge into a single bed south of Uniontown, as shown in the Leith shaft section (Gg6). The overlying Benwood limestone is from 80 to 110 feet thick and consists mainly of dense, fresh-water limestone with some thin interbeds of gray clay shale. It is overlain by an irregular sandstone bed up to 10 feet thick that is tentatively correlated with the Arnoldsburg sandstone. An overlying limestone from 10 to 20 feet thick may be correlated with the Uniontown limestone, but in many places it is not separable from the Benwood member. The Uniontown coal, as identified in the townships to the north and west, was observed in this area from a few outcrops to be a thin, lensy coal lying about 290 feet above the Pittsburgh bed. Although this is the type region for the Uniontown coal, it is generally lacking in stratigraphic sections in these townships. The top coal bed shown in the Leith shaft section may possibly be correlated with the Uniontown coal, although it is only 250 feet above the base of the formation. This is the only occurrence, observed or reported, of a thick coal at this interval in the county. The interval between the Uniontown coal horizon and the Waynesburg coal is occupied by sandstone and shale in the lower part and fresh-water limestone in the upper part. These may be correlated respectively with the Uniontown sandstone and Waynesburg limestone members. The Waynesburg coal lying about 359 feet above the base of the formation is persistent through the area. It crops out extensively in and around Uniontown and was originally called the Uniontown coal by Rogers and Stevenson, who gave the type locality as the cement quarries in Uniontown. This locality could not be found during the present field work, but from locations published by these men, it was found that their so-called Uniontown coal correlates with the Waynesburg coal of Greene and western

Fayette counties. The miscorrelation of the coal probably arose from the misinterpretation of the structural depth of the Uniontown basin, as Rogers placed the coal in question only 200 feet above the base of the formation and Stevenson at about 260 feet above the base. Since the time of their investigations, the development of the Pittsburgh coal has made available several shaft sections which, with the surveyed elevation on the base of the Pittsburgh coal, show the interval to the misnamed Uniontown coal to average 350 feet in the vicinity of Uniontown. This interval plus the characteristics of the coal bed show that the bed correlates with the Waynesburg coal and is not the Uniontown coal that is now generally accepted as occurring about 290 feet above the base of the formation.

PERMIAN

Permian strata underlie a belt 2 to 3 miles wide in the western parts of North and South Union townships along the axis of the Uniontown syncline. The greatest thickness of the formation remaining uneroded is approximately 300 feet. South of Oliver, the strata occur in the hills as isolated areas surrounded by outcropping Monongahela beds, but to the north the Permian rocks crop out continuously across the syncline. Surface exposures in the area are poor and show only short stratigraphic intervals that cannot be correlated together in a composite section. Detailed data on the lower part of the formation is obtained from sections of Oliver Nos. 1 (Gf7) and 2 (Gg1) shafts and the Lemont No. 1 air shaft (Hf2), and from observations of the outcropping beds. The data from the two sources agree only occasionally, thereby indicating a difference in the character of the strata near the middle of the syncline and along the outcrops of the same beds. Generally, the Permian strata in the Uniontown syncline appear to differ greatly from beds of the same age in the Lambert syncline, and correlations cannot be carried across the intervening Fayette anticline. Probably this anticline was a low barrier ridge at the time of deposition and the sediments laid down in each basin were of different characters. From outcrops in the Uniontown syncline, the Permian strata appear to be chiefly drab sandstones and sandy shales in the basal 100 feet and drab to dark shales and sandy shales through the overlying section. Thin beds of limestone occur at irregular intervals and cannot be definitely correlated. This is also true of the coals that occur sporadically as lenses and have no value. Outcrop observations show the Waynesburg coal to be overlain by 0 to 20 feet of gray to black Cassville shale, which is in turn overlain by a good development of the Waynesburg sandstone up to 50 feet thick. Although this sequence was observed at all outcrops, the strata overlying the Waynesburg coal in the mine shaft sections are reported to consist chiefly of shale and clay shale with some limestone and sandstone beds. Two and sometimes three coal beds that overlie the Waynesburg sandstone may represent the Waynesburg A and B coals. If so, the Waynesburg A bed lies 50 to 80 feet above the base of the formation and the Waynesburg B coal, occurring as a split bed, lies 85 to 110 feet above the base. The strata above these coals are not correlated because of insufficient information.

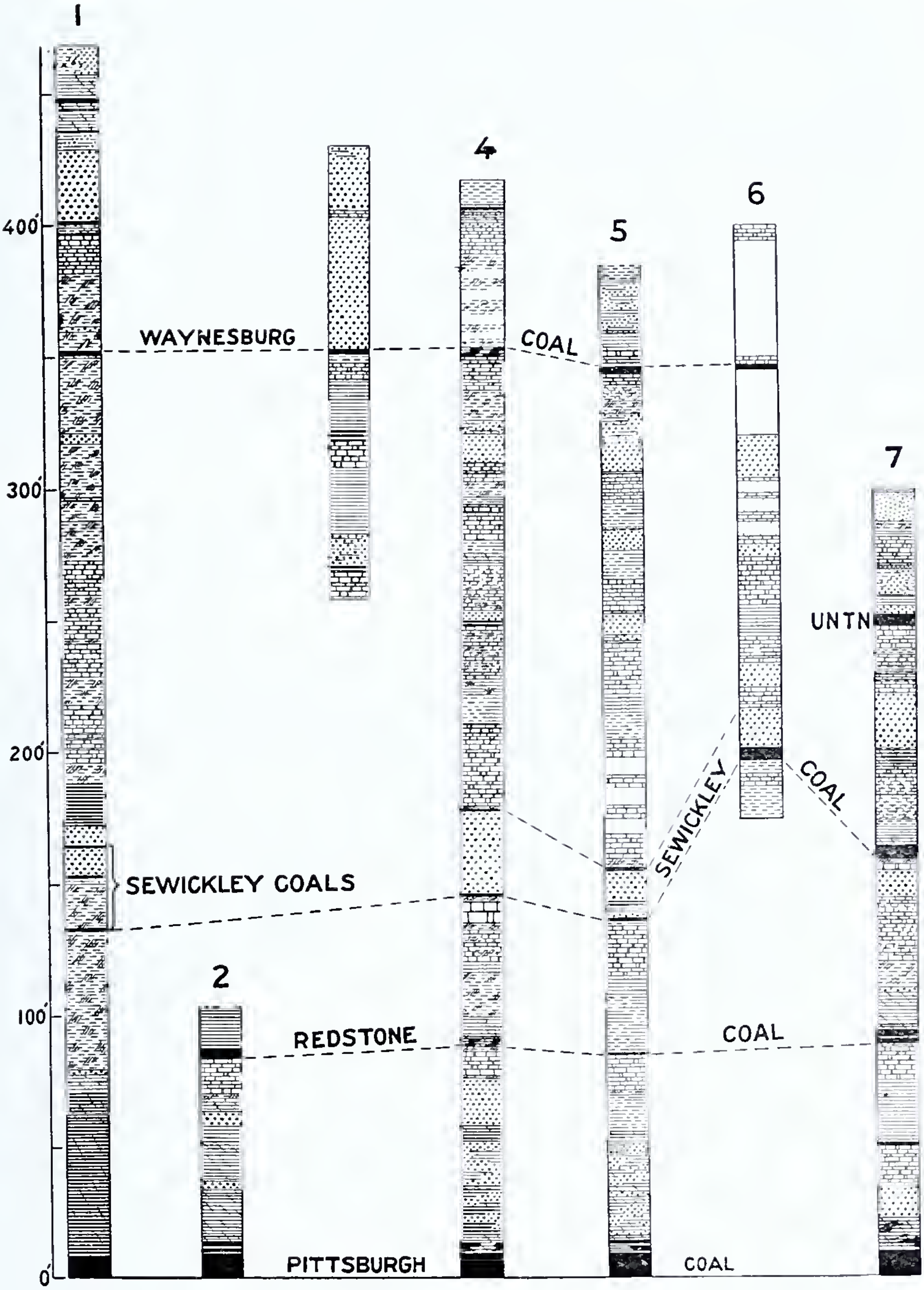

Figure 83. Stratigraphic sections in North and South Union Townships.
1. Lemont No. 1 air shaft; H. C. Frick Coke Co. (Hf2).
2. Lemont No. 2 air shaft; H. C. Frick Co. (Hg2).
3. Section on Shutes Run (Hg) as measured by J. J. Stevenson: Pennsylvania Second Geol. Survey, Report KK, p. 163.
4. Oliver No. 1 shaft; Oliver and Snyder Steel Co. (Gf7).
5. Oliver No. 2 shaft; Oliver and Snyder Steel Co. (Gg1).
6. Section on Redstone Creek (Gg) as measured by J. J. Stevenson: Pennsylvania Second Geol. Survey, Report KK, p. 154.
7. Leith shaft; H. C. Frick Coke Co. (Gg6).

Coal Resources

The Pittsburgh and Sewickley coal beds of the Monongahela formation are the important commercial coals in North and South Union townships. Custom or house coal is frequently obtained from the Waynesburg bed of the Monongahela formation and the Upper Freeport, Lower Kittanning and Brookville-Clarion beds of the Allegheny formation. These may become important coals in the future.

The Allegheny coals were observed only on the flank of Chestnut Ridge where the strata are dipping steeply and the formation is abnormally thin. This thin section apparently persists along Chestnut Ridge, but the formation is believed to resume its normal thickness to the west before the axis of the Uniontown syncline is reached. The following table of intervals between the Allegheny coals applies only to the thin section along the outcrop.

Intervals to Upper Freeport coal in North and South Union Townships, in feet

Coal	Average	Range
Upper Freeport (top)	0	0
Lower Freeport	50	35 to 60
Upper Kittanning (?)	80	75 to 85
Lower Kittanning	105	100 to 120
Brookville-Clarion	165	150 to 175

Coals of the Pottsville, Conemaugh, and Permian times are thin and are not valuable commercially. Intervals between coal beds in these formations are not given. The Pittsburgh-Upper Freeport interval in the area averages about 650 feet. The following table lists intervals between coals of Monongahela age:

Intervals to base of Pittsburgh coal in North and South Union Townships, in feet

Coal	Average	Range
Waynesburg (top)	350	335 to 360
Uniontown	280	250 to 310
Sewickley	135	120 to 170
Redstone	85	80 to 90
Pittsburgh Rider	50	35 to 60
Pittsburgh (base)	0	0

ALLEGHENY COALS

The Brookville-Clarion, Lower Kittanning, and Upper Freeport coal beds are believed to have mineable thicknesses through the area. The Upper Kittanning and Lower Freeport beds were found at only a few localities, in all of which they are less than 12 inches thick.

The following discussion is limited to observations of the Allegheny coals along their lines of outcrop on the flank of Chestnut Ridge.

Brookville-Clarion or A coal. Although this coal was not observed along the outcrop of the Allegheny formation north of Coolspring (Ig), it is probably persistent through both North and South Union townships. In and south of Coldspring Hollow the bed is unusually thick, between 5 and 8 feet. It contains one persistent clay parting from 2 to 9 inches that occurs slightly below the middle of the bed.

Several non-persistent shale and bone binders up to 2 inches thick occur in the lower section of the coal. Where the bed is thickest, the middle part is composed of slightly bony and hard coal. The coal is underlain usually by gray plastic clay, but locally a thin layer of hard black shale occurs between the clay and the coal. A gray shale from 3 inches to 5 feet thick commonly overlies the coal bed. This shale is overlain by a heavy- to massive-bedded sandstone which may frequently rest directly on the coal.

Lower Kittanning or B coal. The Lower Kittanning coal appears as a persistent bed about 105 feet below the Upper Freeport. Only one detailed section was measured; it showed 26 inches of clean coal, but numerous observations on more or less weathered outcrops indicate that this bed is from 18 to 30 inches thick and is free of partings. The bed is underlain generally by gray plastic clay and overlain by 10 to 25 feet of black to gray shale.

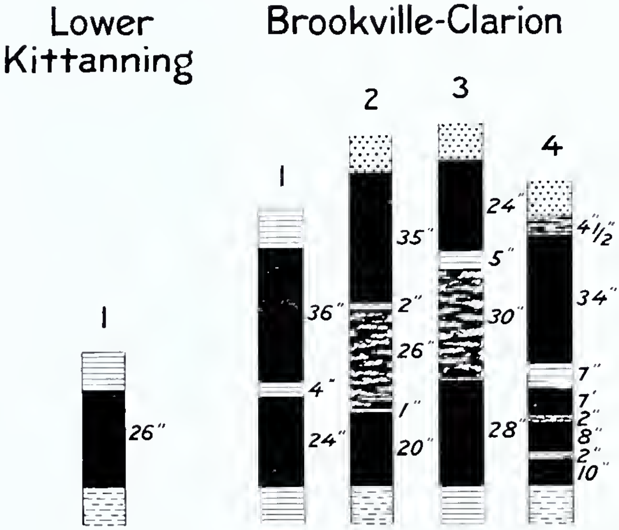

Figure 84. Sections of Allegheny coals in North and South Union Townships.

Lower Kittanning coal: 1. Ig4.
Brookville-Clarion coal: 1. Ig2. 2. Hh3. 3. Hh4. 4. Hh9.

Upper Freeport or E coal. The E coal has a thickness of 30 to 54 inches along its outcrop north of Lick Run (Hh). In this section, the top 24 to 36 inches is fairly clean coal without binders, but the lower part of the bed contains one to three clay, shale, or bone partings from ½ to 6 inches thick. The uppermost of these binders is very persistent and is thickest. The basal 4 to 6 inches of the bed contains scattered pyrite balls. In the area just west of Pine Knob (Hh) several openings along the headwaters of Redstone Creek show the Upper Freeport coal unusually thick, 8 to 9 feet. Here the bed has two clay partings from 10 to 15 inches thick that divide it into three general benches. The upper bench from 6 to 12 inches thick is a rather dirty or bony coal, the middle bench from 36 to 42 inches thick generally has a 2-inch shale binder near its base, and the bottom bench from 30 to 36 inches thick has a 1- to 3-inch clay parting near its top. The top portion of the bottom bench is generally bony coal. South of this area, the Upper Freeport bed was not observed, but the thick section is believed to continue southwestward into Georges Township, where the coal has similar thicknesses. In North and South Union townships, the coal is underlain by a variable thickness of gray shale or plastic clay and is overlain in normal occurrence by 3 to 15 feet of gray to drab clay shale and clay. Locally, the overlying Mahoning sandstone may rest directly on or replace some of the coal bed. Numerous lenses and balls of pyrite occur throughout the thickness of the bed.

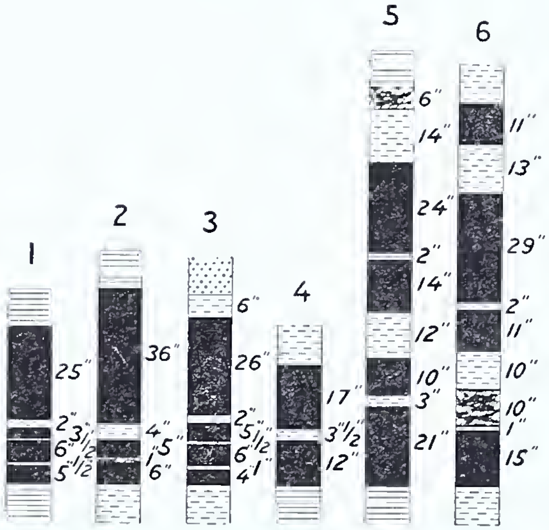

Figure 85. Sections of Upper Freeport coal in North and South Union Townships.

1. Ig3. 2. Ig3. 3. Hh1. 4. Hh2. 5. Hh7. 6. Hh8.

MONONGAHELA COALS

The Monongahela coals underlie the western parts of these townships where the Pittsburgh and Sewickley beds have been mined for a long time. The Redstone and Waynesburg beds have mineable thicknesses, but have been developed only for custom coal.

Pittsburgh coal. The Pittsburgh coal at the base of Monongahela formation is the most important coal in North and South Union townships. A variable thickness of dark to black shale generally separates the coal bed from the overlying Pittsburgh sandstone, although locally this sandstone may rest directly on the coal. The Pittsburgh coal is a double-benched bed through the area, showing the upper or roof-coal division, the middle or main clay parting (draw-slate), and the lower or main division. The roof coal is commonly present as a series of dirty coal and black shale layers with a total thickness of 3 to 8 feet. It is too dirty to have any value. In the southeast corner of its area of occurrence in these townships, it becomes a very hard bone coal or cannel shale that has a blocky appearance. The main clay parting (overclay or draw slate) has a persistent occurrence through the area and has an average thickness of about 9 inches. The lower or main division, which contains the commercial coal of the bed, is from 7½ to 9 feet thick. It exhibits the subdivisions known from top to bottom as the breast, bearing-in, and bottom coals. The breast coal from 52 to 68 inches thick consists generally of clean coal free of persistent binders or impurities. The top 6 to 8 inches of this section contains infrequent occurrences of pyrite knife-edges and balls. This portion is frequently left in place as support for the roof in first mining and is recovered in second mining. Locally a thin non-persistent shale binder, known as the "penny slate," is found near the middle of the breast coal. The bearing-in coal is from 3 to 6 inches thick and consists of a layer of coal 2 to 4 inches thick bounded on the top and bottom by shale binders that are generally ½ inch thick. These shale binders are the only persistent ones in the lower division. Each of them ranges from a knife-edge to ¾ inch thick or may be replaced locally by a bone coal. The bottom coal comprising the basal part of the lower division is from 28 to 40 inches thick. It is free of persistent binders and consists of clean coal in all except the bottom 6 inches, which may contain some pyrite lenses and balls. Frequently this section is left in place during the first mining. The upper 12 to 24 inches of the bottom coal has a blocky character and evidently corresponds to the brick coal of other regions. The floor of the Pittsburgh coal is generally a plastic gray clay, but dark shale may be present at places. The clay commonly contains balls and thin beds of iron carbonate which in the past was mined along the eastern outcrop to supply the nearby iron furnaces.

The only irregularity reported in the Pittsburgh coal bed is a "fault" in the Mount Braddock mine (If4). This "fault" starts at the outcrop, follows a southwest course for an undetermined distance, and affects a maximum width of 100 feet. It is reported to affect chiefly the bottom coal of the lower division and apparently replaces this section either partly or entirely with shale. This so-called "fault" appears to be entirely different from the erosional channels found in Springhill Township and probably represents a local shale lens of more than usual thickness that was deposited at the same time as the coal.

Redstone coal. The Redstone coal lying 85 feet above the base of the formation is persistent through the area. It ranges between 1 and 5½ feet in thickness, and where observed, it consisted of a fairly hard, dirty or bony coal. Where thickest, the bed is separated into two benches by a clay parting 2 to 5 inches thick, and the bottom bench is a bone coal. The roof of the Redstone coal is gray clay shale and the floor is plastic gray clay which frequently shows limestone nodules.

Sewickley coal. The Sewickley coal is split into two and sometimes three beds north of Uniontown. At places, the upper and lower splits may be separated by as much as 30 feet of intervening strata. The

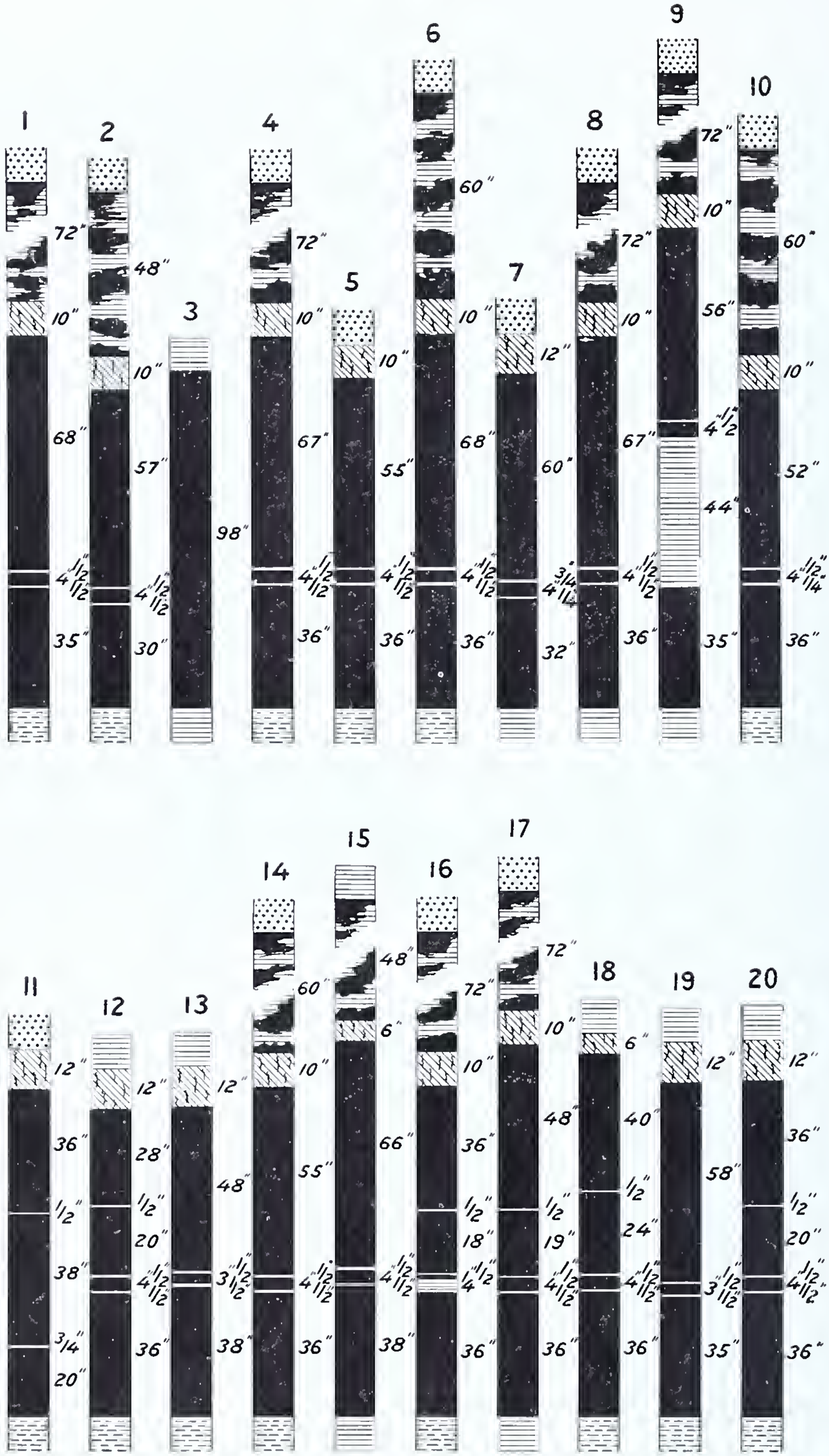

Figure 86. Sections of Pittsburgh coal in North and South Union Townships.

1. If4, Mt. Braddock mine. 2. If9, Youngstown mine. 3. Hf2, Lemont No. 1 air shaft. 4. Gf3, Oliver No. 3 mine. 5. Gf4, Phillips mine. 6. Gf6, Ball mine. 7. Gf7, Oliver No. 1 mine. 8. Ff2, Snyder mine. 9. Gg1, Oliver No. 2 mine. 10. Gg3, Continental No. 1 mine. 11. Gg4, South Union mine. 12. Gg5, Redstone shaft. 13. Gg6, Leith mine. 14. Hg1, Lemont No. 1 mine. 15. Hg2, Lemont No. 2 air shaft. 16. Hg9, Lemont No. 2 mine. 17. Hg10, Stewart No. 1 mine. 18. Hg13, Crossland mine. 19. Gh2, Margaret mine. 20. Gh4, Redstone slope.

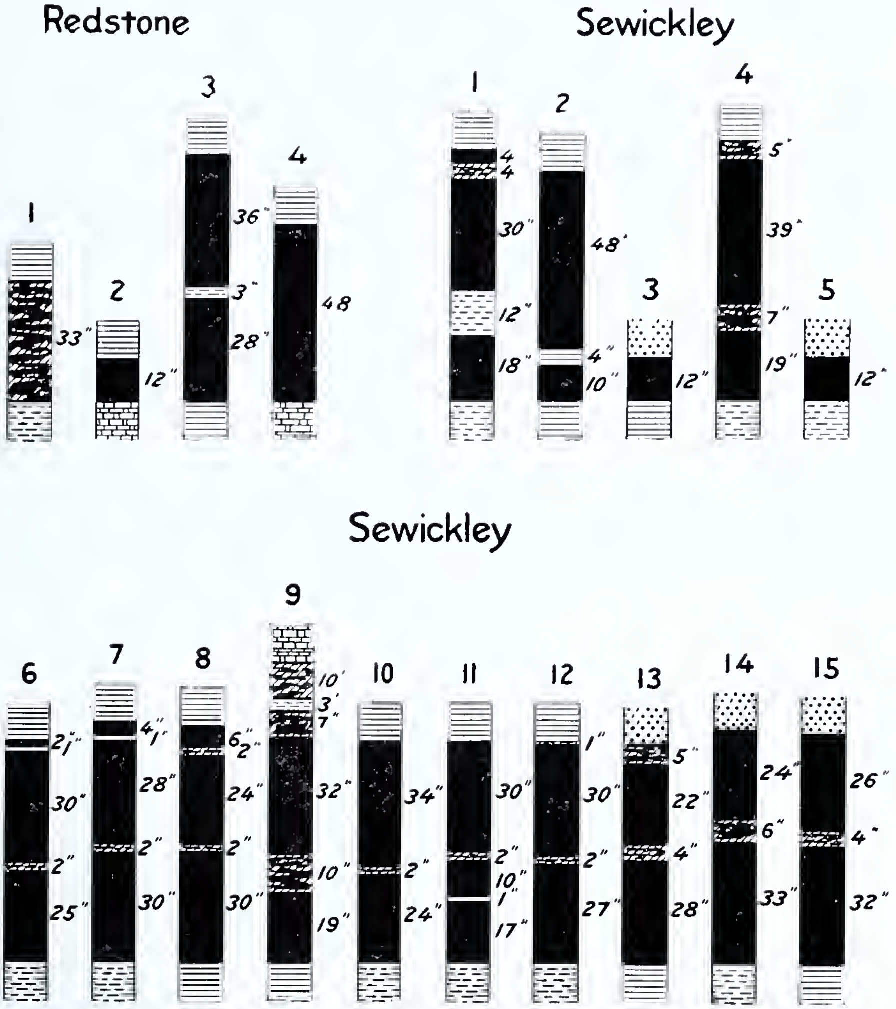

Figure 87. Sections of Redstone and Sewickley coals in North and South Union Townships.

Redstone coal: 1. Gf7, Oliver No. 1 shaft. 2. Gg1, Oliver No. 2 shaft. 3. Gg6, Leith shaft. 4. Hg2, Lemont No. 2 air shaft.

Sewickley coal: 1. If6, Percy mine. 2. If8, Gaddie mine. 3. Hf2, Lemont No. 1 air shaft. 4. Hf5, Hogsett mine. 5. Gg1, Oliver No. 2 shaft. 6. Gg7, Sadie mine. 7. Gg8, Marine mine. 8. Gg9, Martha mine. 9. Hg3, Evans No. 3 mine. 10. Hg8, Brinker mine. 11. Hg11, Stewart No. 2 mine. 12. Hg12, Craig mine. 13. Gh1, Meadowbrook mine. 14. Gh3. 15. Gh5.

lower split is more persistent and important than the middle and upper beds, which apparently reach mineable thickness only locally. South of Uniontown the three splits merge into one persistently mineable bed that lies about 135 feet above the Pittsburgh coal. This occurrence as a single bed is also believed to take place along the east limb of the syncline north of Uniontown at some place between the axis and the outcrop of the coal. The Sewickley coal has been opened commercially at numerous places along its eastern outcrop and across the entire width of the Uniontown syncline, south of the National Pike. On the west limb of the syncline north of the National Pike, it apparently is not of mineable thickness. Where mineable in the area, the Sewickley coal is from 5 to 7 feet thick and occurs commonly as a double-benched bed. Locally, a third bench from 2 to 10 inches thick was observed on top of the main bed and separated from it by 1 to 3 inches of black shale or bone coal. The main part of the bed is divided into two sections by a 2- to 12-inch clay or bone coal parting. Lenses of bone coal and black shale up to 2 inches thick occur in both benches of the main bed, and the top 6 inches of the bed is often a bone or dirty coal. Streaks and balls of pyrite are found throughout the section and are numerous near the top and bottom of the bed. The Sewickley coal is underlain by a gray plastic clay or shale and is overlain generally by a more or less plastic gray clay shale that tends to soften and slack after exposure to air. The overlying Sewickley sandstone rests directly on the coal over sizable areas, especially in South Union Township. In places the sandstone replaces the upper part of the coal.

Because of the plastic nature of the immediately underlying and overlying strata, numerous clay veins from 2 to 20 feet thick cut through the coal. These veins are reported to persist for miles and in some mines they are said to follow more or less the strike of the bed.

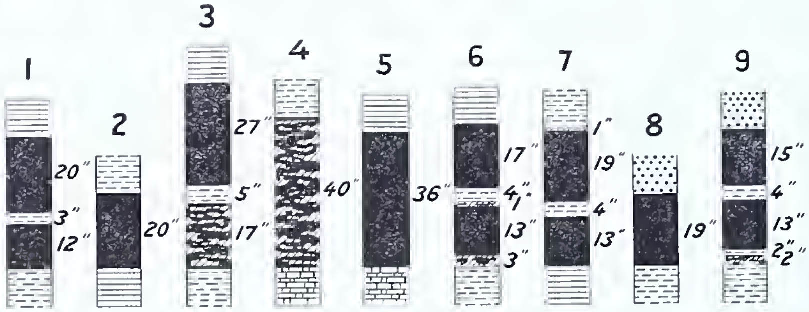

Figure 88. Sections of Waynesburg coal in North and South Union Townships.

1. Hf1. 2. Hf2, in Lemont No. 1 air shaft. 3. Hf4. 4. Gf7, in Oliver No. 1 shaft. 5. Gg1, in Oliver No. 2 shaft. 6. Gg2. 7. Hg4. 8. Hg5. 9. Hg6.

Uniontown coal. The Uniontown coal is less than 15 inches thick along its line of outcrop. However, in the Leith shaft a coal bed 4½ feet thick is reported to occur at the horizon of the Uniontown coal. This thickness is unusual; measurements made or reported elsewhere in the area do not approach this figure. The Uniontown coal lies 250 to 310 feet above the base of the Pittsburgh coal, where it has a fairly persistent occurrence.

Waynesburg coal. The Waynesburg coal lies about 350 feet above the base of the formation and is persistent through North and South Union townships. This coal was formerly correlated with the Uniontown coal horizon, but as shown elsewhere in the report, it is correlated more properly as the Waynesburg coal. It crops out in the western parts of the townships along both limbs of the Uniontown syncline where it occurs usually as a double-benched bed from 20 to

50 inches thick. A clay parting from 3 to 6 inches thick just below the middle of the bed separates the upper from the lower bench. The upper bench is fairly clean coal, but the lower bench contains hard coal that is somewhat bony and often has a thin clay parting near the base. In normal occurrence the Waynesburg coal is underlain by gray to dark shale or clay and is overlain by dark to drab shale from 3 to 15 feet thick. The overlying Waynesburg sandstone frequently cuts out the intervening shale and rests directly on the coal. The Waynesburg coal has been mined for custom coal near Uniontown and Bute.

Clay and Shale

The clay and shale deposits of North and South Union townships have not been developed. Fire clays of the Allegheny and Conemaugh formations, such as the Lower Kittanning, Bolivar and Mahoning, are probably present in good thicknesses along the outcrop of these formations on the slopes of Chestnut Ridge. Vast quantities of shale that possibly are suitable for building brick are present in the Mauch Chunk, Allegheny, Conemaugh, Monongahela and Permian formations. Test on Mauch Chunk shale outcropping along the National Pike show it to be suitable for building brick or hollow tile.

Limestone

Limestone beds at several different horizons have been quarried in North and South Union townships and used for varied purposes. In Coolspring Hollow, the Loyalhanna limestone is quarried for paving block and crushed stone. The Greenbrier limestone has been opened at numerous places along its outcrop on Chestnut Ridge for road metal and agricultural limestone. In the Monongahela formation, the Fishpot, Benwood, Uniontown, and Waynesburg limestones have all been quarried at some time in the past chiefly for road metal and agricultural stone. Some was used for fluxing stone in the iron industry that flourished in Fayette County about 50 to 100 years ago. Stevenson reports the use of the Waynesburg limestone near Uniontown to manufacture cement that was used locally and in the locks and dams on the Monongahela River. The limestone beds of the Allegheny, Conemaugh and Permian formations are thin and have not been utilized. Detailed descriptions, analyses, and tests on the various limestone beds in North and South Union townships are given in the discussion on limestone resources in this report.

Sandstone

Unlimited quantities of sandstone for most any purpose are available in these townships. The most persistent thick beds are the Burgoon of the Pocono series; the Connoquenessing and Homewood of the Pottsville; Clarion of Allegheny; Mahoning, Saltsburg, Morgantown and Connellsville of the Conemaugh; and the Waynesburg sandstone of the Permain formation. All of these are suitable for road metal or building stone and some are probably adaptable to special uses. The sandstone resources have not been developed to any extent, but many small quarries have supplied road metal or building stone.

Oil and Gas

Most of the area included in North and South Union townships is unfavorable to oil and gas occurrences because of the structure, which is almost entirely in the Uniontown syncline. The only favorable place is along the eastern boundary on the crest of Chestnut Ridge anticline, where considerable quantities of gas have recently been discovered near Summit in the deep-lying Onondaga formation or near its horizon. Gas production from the so-called shallow sands on Chestnut Ridge is rather doubtful because the broken character of the strata on this anticline would allow the gas to escape. However, the Onondaga sand lies about 6,500 to 7,000 feet below the surface and any gas contained therein would be sealed in by overlying impervious shales. A detailed discussion of this gas field on the crest of Chestnut Ridge is given in the special chapter on the subject.

CONNELLSVILLE AND DUNBAR TOWNSHIPS

Connellsville and Dunbar townships are discussed as a unit because of the similarity of their outcropping strata and underlying rock structure. They lie in the north-central part of the county and extend from Brush Ridge eastward to several miles past the crest of Chestnut Ridge. The approximate center of the unit is in map quadrilateral Je. Connellsville, the second largest city in the county, is included in the description.

The Youghiogheny River forms the common boundary of the two townships; it and its tributaries drain the area. The river pursues a winding northwest course except in the gorge through Chestnut Ridge, where the course is westerly. Minor streams draining Connellsville Township are Galley Run, Mounts Creek, Connell Run, and Laurel Run. They have south or west courses and empty into the Youghiogheny River. In Dunbar Township Dickerson Run, Opossum Creek, Dunbar Creek and Laurel Run have general north or northeast courses and drain into the Youghiogheny River. Dunbar Creek is the only minor stream in Fayette County that cuts through Chestnut Ridge. From its source in the area known as Paul Flats, it flows northeast for several miles on the east side of the ridge and then cuts northwest through the ridge, resuming a northeast direction at Dunbar and emptying into the Youghiogheny River opposite South Connellsville.

The part of the area lying west of Chestnut Ridge is in the mature dissected plateau region of western Pennsylvania. Here the hilltops have a general altitude of 1,200 to 1,300 feet and have either small flat or gently rounded tops. The minor streams have moderately wide valleys with gently sloping sides in their upper courses, but in the lower courses they become entrenched. The Youghiogheny River is deeply entrenched in a nearly cliff-sided valley. Flats 150 feet above the river near Connellsville and New Haven are remnants of the old course of the Youghiogheny River in Pleistocene time. Eastward from Dunbar and Connellsville the slopes rise rapidly to the crest of Chestnut Ridge, where the highest knobs have altitudes of 2,000 to 2,300 feet. This general level of rounded knobs persists eastward to the east boundary of the area. Dunbar Creek and Youghiogheny River have cut gorges 1,000 feet deep through Chestnut Ridge and minor streams have cut deep notches into the slopes of this ridge. The southern and eastern half of Dunbar Township, including Paul Flats, is a sparsely settled, forested area of strong relief.

Coal mining, beehive coke manufacture, sandstone quarrying (for silica brick and glass sand), limestone quarrying and refractory clay mining are among the principal industries in the area. Other important industries are railroading, farming and manufacturing. Five railroads, the Baltimore & Ohio, Pennsylvania, Western Maryland, Pittsburgh & Lake Erie, and the Pittsburgh & West Virginia Railway Companies operate in this area. Several of these maintain large freight yards and repair centers in or near Connellsville, which is on the direct Pittsburgh-Baltimore route.

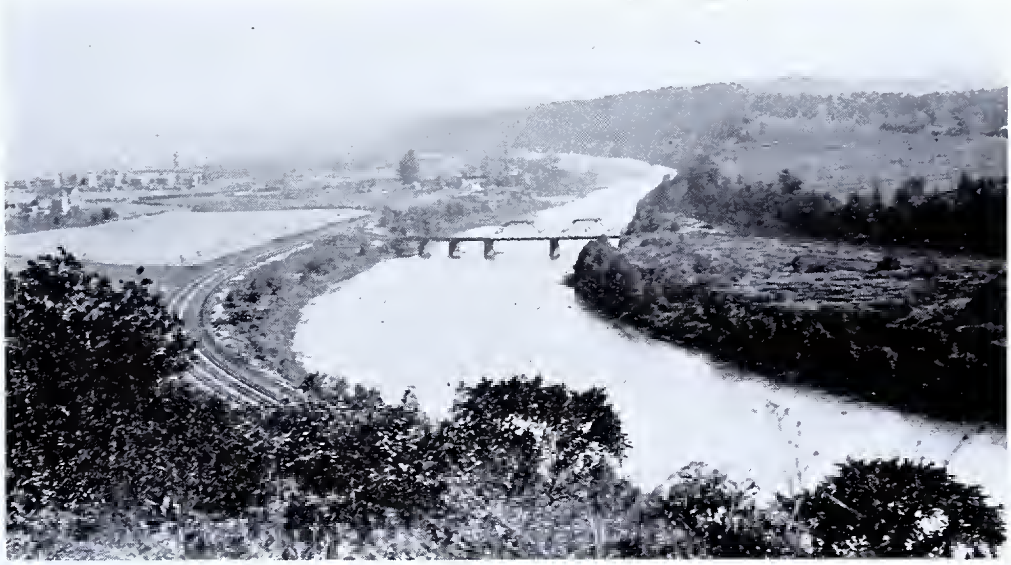

Figure 89. Youghiogheny River two miles north of Connellsville.

Structure

Connellsville and Dunbar Townships extend structurally from the east flank of the Fayette anticline eastward across the Uniontown syncline and the Chestnut Ridge anticline, nearly to the axis of the Ligonier syncline. The axis of the Uniontown syncline has a southwest course through the western parts of both townships. It plunges southward, losing about 310 feet in structural elevation from the north boundary of Connellsville Township to the south boundary of Dunbar Township. The bottom of the syncline is relatively wide and flat in the southern part of the area, but is shaped somewhat like the prow of a canoe in the northern part. On the west flank of the Uniontown syncline, the strata have a maximum rise of 180 feet to the mile, but on the steeply rising east flank, the strata have a maximum inclination of about 1,000 feet to the mile. They rise slowly for a short distance eastward from the axis of the syncline and then at a rapidly increasing rate until until within two miles of the axis of the Chestnut Ridge anticline, from which point the rate of rise decreases. Maximum amplitude between the axes of the syncline and anticline is 2,700 feet. The axis of the Chestnut Ridge anticline, as judged from the best data available, is not continuous through the area, but apparently is slightly offset to the west in the region known as Paul Flats (Jf, Kf) in Dunbar Township. The anticline, entering from the northeast, is narrow-crested and has a slight southward plunge. South of the Youghiogheny River, the course of the axis changes from southwest to southerly and the axis appears to follow a pronounced spur on the east flank of the main anticlinal structure. This directional change takes place about 3 miles south of the Youghiogheny River in a heavily wooded area where both the topographic and geologic mapping are more or less questionable. About 1½ miles west of this point of change, the axis of the main anticline starts again and pursues a rapidly rising southwest course in which it gains 450 feet of structural elevation to the south township line. This section of the anticline has a narrow, sharp crest. It is separated from the spur on east flank by the shallow end of the Ligonier syncline. The anticlinal spur has a broad, relatively flat top through the remainder of its southerly course in Dunbar Township. On the east flank of the Chestnut Ridge anticline, the strata dip into the Ligonier syncline with a maximum rate of decline of 450 feet to the mile. In the extreme east corner of Dunbar Township, which is within ½ mile of the synclinal axis, the strata are relatively flat with only a slight eastward dip.

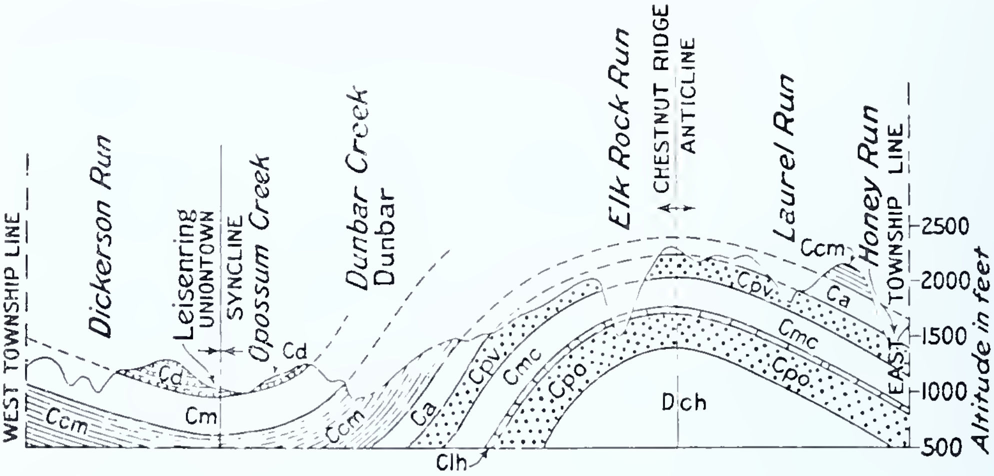

Figure 90. Structure section across Dunbar Township.

Legend: Cd—Dunkard formation; Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpo—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series; Dch—Post-Chemung and Chemung formation.

The underlying rock structure of the area is contoured on two datum planes, the base of the Pittsburgh coal in the west half and the top of the Upper Freeport coal in the east half. Contour interval on the Pittsburgh coal is 20 feet and on the Upper Freeport is 50 feet. The junction line of the two datum planes lies along the west base of Chestnut Ridge and represents either the 1,300 foot contour on the Pittsburgh coal or the 650-foot contour on the Upper Freeport coal.

Stratigraphy

Consolidated strata that crop out in Connellsville and Dunbar townships range from post-Chemung and Chemung of Devonian time to the Dunkard formation of Permian time. The total thickness of exposed sediments is approximately 2,950 feet. Unconsolidated deposits of Pleistocene and Recent ages occur along the Youghiogheny River west of Chestnut Ridge.

DEVONIAN

Chemung and post-Chemung strata. Upper Devonian strata crop out in the gorge of the Youghiogheny River through Chestnut Ridge and in the valley of Dunbar Creek at the mouths of Elk and Tucker Runs. In the gorge, about 575 feet of Chemung and post-Chemung strata are above drainage. Along the tracks of the Western Maryland Railroad on the east flank of Chestnut Ridge anticline, nearly 200 feet of shales and sandstones, chiefly red, are exposed. From the top of this exposure to the base of the Pocono series, the interval is estimated to contain about 250 feet of concealed strata, which is indicated by the float to be mainly gray shale and sandstone. According to Willard's determinations of the relationships of the Pocono, Catskill and Chemung formations in Fayette County, the red beds of the above section would represent an interfingering of non-marine Catskill sedimentation from the east into marine Chemung sediment on the west. Hence this section of strata underlying the Pocono series is assigned, in this report, the indeterminate name of Chemung and post-Chemung. The lithologic relationship of the Pocono, Catskill, and Chemung formations in Fayette County as compared with that of sections nearby will be presented more fully under the stratigraphic discussion of Henry Clay and Stewart townships.

MISSISSIPPIAN

Pocono series. The Pocono series crops out in the Youghiogheny River gorge and the upper valley of Dunbar Creek in Chestnut Ridge. The strata are dominantly gray, coarse-grained sandstone containing some beds of gray shale and sandy shale. Conglomerate beds, with white-quartz pebbles up to ¾ inch size, are not uncommon. The series is believed to have an average thickness of about 300 feet, limited at the top by the Loyalhanna formation and at the bottom by a horizon of Devonian fauna. In Connellsville and Dunbar townships the top 240 feet are exposed along the Western Maryland Railroad tracks on the west flank of the Chestnut Ridge anticline. The gray conglomerate bed 10 feet thick that lies at the bottom of the section about 490 feet below the Loyalhanna limestone, is correlated tentatively with the Berea of the oil and gas industry. However, it lies under shales in which Devonian fossils have been found and probably does not correlate on a faunal basis with the type Berea sand of northern Pennsylvania and Ohio which is definitely Mississippian. The basal section of the Pocono is concealed, so that a total thickness in these townships cannot be given.

Loyalhanna formation. The Loyalhanna formation, lying on the Pocono series, crops out along Connell Run, Youghiogheny River, and Dunbar Creek in their valleys in Chestnut Ridge. Exposures in the area show the formation to be about 60 feet thick (range 55 to 65 feet) and to consist of thin, highly cross-bedded layers of calcareous sandstone, composed of fine sand grains cemented by calcium carbonate. The strata are dense and homogeneous and have a gray color on fresh fractures and a light blue-gray color on weathered surfaces. Several active quarries along the Youghiogheny River and Dunbar Creek expose nearly complete sections of the formation and along the Western Maryland Railroad a continuous outcrop exposes the formation from top to bottom.

Mauch Chunk formation. The Mauch Chunk formation lies above drainage in the mountainous section of these townships, where it is exposed in all the stream valleys cut into the sides or through Chestnut Ridge. It exhibits the usual characteristics and make-up, consisting chiefly of red shales and sandy shales with some green and drab shale and sandstone beds. The Greenbrier limestone, a persistent member, lies from 25 to 50 feet above the base of the formation. This member, from 10 to 20 feet thick, is composed of blue-gray, fossiliferous limestone and shale. The shale occurs in the upper part of the Greenbrier member where it separates several thin limestone beds. The lower section generally contains several fairly thick limestone beds with little or no intervening shale. Numerous quarries for agricultural lime have been opened on the Greenbrier member.

Exposures of the Mauch Chunk formation are limited to short stratigraphic sections, and definite measurements of total thickness could not be made. It is believed that the formation in Connellsville and Dunbar townships has an average thickness of about 225 feet.

PENNSYLVANIAN

Pottsville formation. Strata of the Pottsville formation cap the high knobs along the crest of Chestnut Ridge and the spurs on its west flank. In the eastern and southern parts of Dunbar Township the formation is exposed in the steep sides of valleys and in some places in the valley floors. The best exposures are along the Youghiogheny River and Dunbar Creek (Ke, Kf, Jf), where five members are recognized. The basal member or Lower Connoquenessing sandstone, consisting of gray, iron-stained, heavy-bedded, coarse-grained to conglomeratic sandstone, is about 50 feet thick. It is overlain sporadically by the Quakertown coal and shale member, which is from 0 to 15 feet thick and occurs as lenses.

The Upper Connoquenessing sandstone member has an average thickness of 50 feet along Dunbar Creek, where it consists of heavy-bedded, medium- to coarse-grained sandstone. Generally it is iron stained, but locally, as in the mine of the Dunbar Corporation, the sandstone is relatively free of iron compounds. The Mercer coal and shale member is not well exposed in Connellsville and Dunbar townships. However, it appears to be persistent and to be from 15 to 35 feet thick, consisting of black to drab shale and coal. It is overlain by the light-gray, massive-bedded Homewood sandstone. This member averages about 90 feet thick and consists of coarse-grained sandstone with some conglomerate lenses (pebbles up to ½ inch). The upper 15 feet of the Homewood sandstone is commonly drab, medium-grained, slabby sandstone.

Allegheny formation. The Allegheny formation crops out in the foothills and partly up the spurs on the west flank of Chestnut Ridge in the two townships. In eastern and southern Dunbar Township it caps the flat-topped hills from Paul Flats (Jg, Kg) northeastward to the Youghiogheny River, and extends in continuous outcrop down the stream valleys to the east township boundary. Exposures of the formation are usually fragmentary and, because of the steep structural dips and the rugged, wooded character of the area of outcrop, detailed information on this group of strata is lacking. The only completely exposed section (Je) is along the Western Maryland Railroad on the west flank of Chestnut Ridge. In this section the formation has a thickness of 150 feet, but farther south in the diamond drill hole (If3) of the Eureka Fire Brick Company, its thickness is 175 feet. This subnormal thickness, as substantiated by other sections in the county, is believed to persist through the entire length of Chestnut Ridge in Fayette County. However, sections of the Allegheny formation just east and west of Chestnut Ridge indicate that the formation resumes its normal thickness before either the Ligonier or Uniontown synclinal axes are reached. A complete description of this change is found in the county-wide stratigraphy discussion of the Allegheny formation. Generally the formation in Connellsville and Dunbar townships is composed of dark to drab shale with thin lenses of sandstone. Locally a medium-bedded sandstone lies between the Lower Kittanning and Brookville-Clarion coals. Coal beds that reach mineable thicknesses in the area are the Upper and Lower Freeports and the Lower Kittanning. Important Allegheny clays are the Upper Freeport underclay, Bolivar flint clay and the Lower Kittanning underclay.

Conemaugh formation. The Conemaugh formation underlies a belt, ¾ to 1½ miles wide, through the central parts of the townships and parallel to Chestnut Ridge. In the eastern part of Dunbar Township basal Conemaugh strata cap the hilltops. Discontinuous exposures along the Youghiogheny River and Dunbar Creek show the formation to be about 640 feet thick and to consist mainly of shales with several well-developed persistent sandstone horizons. At the base the Mahoning member consists of medium- to heavy-bedded, coarse-grained beds of sandstone with a shale and clay interval near the middle. It is persistent through the area and is overlain by approximately 130 feet of drab to dark shale which shows local developments of the Buffalo sandstone. The Saltsburg sandstone, a thin- to medium-bedded member that is fairly persistent, is overlain by about 200 feet of shale and

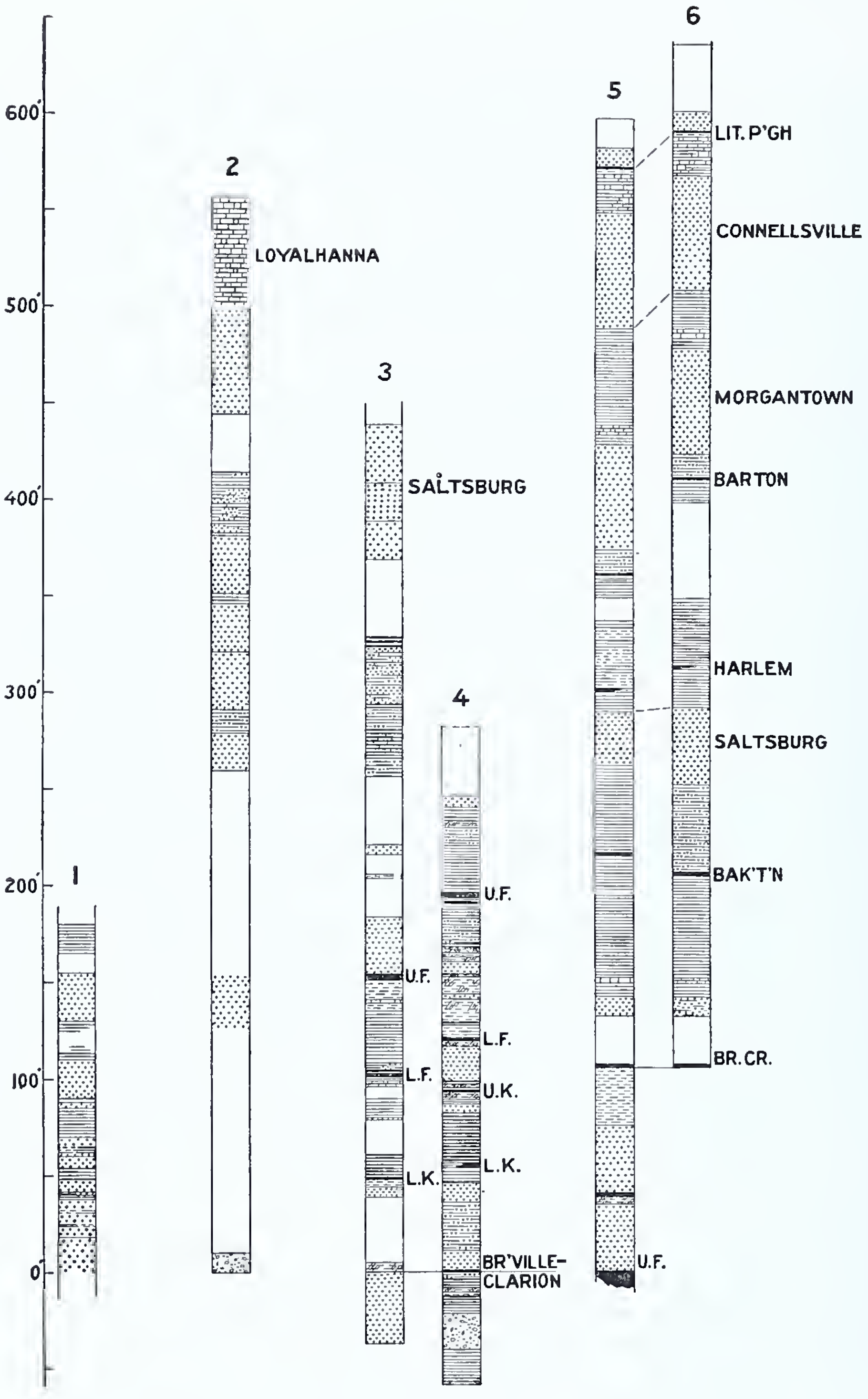

Figure 91. Stratigraphic sections in Connellsville and Dunbar Townships.

1. Devonian section along Western Maryland Railroad (Le) in gorge of Youghiogheny River on east flank of Chestnut Ridge anticline. Top of section is approximately 550 feet below the top of the Pocono sandstone.
2. Section of Loyalhanna limestone and Pocono sandstone along Western Maryland Railroad (Je, Ke) in gorge of Youghiogheny River on west flank of Chestnut Ridge.
3. Section of Allegheny and basal Conemaugh formations along Western Maryland Railroad (Je) in gorge of Youghiogheny River on west flank of Chestnut Ridge.
4. Section of upper Pottsville, Allegheny, and basal Conemaugh formations in diamond drill hole (If3) of Eureka Fire Brick Company.
5. Basal Conemaugh formation as measured by J. J. Stevenson along Dunbar Creek (Je). Second Pennsylvania Geol. Survey, Report KK, pp. 182-83.
6. Middle and upper Conemaugh formation along Dunbar Creek (Je).

clay shale which contains a good development of the Washington red beds. Above this shale interval, the Morgantown member, although persistent, is a thin- to medium-bedded, medium-grained sandstone with numerous shale and sandy shale beds. The Connellsville sandstone, named from exposures around Connellsville, is persistent through the area and is composed mainly of thin- to heavy-bedded sandstone with minor amounts of drab sandy shale and shale. Near the top of the Conemaugh formation the Lower Pittsburgh sandstone is well developed locally, as at Juniataville (He), where it is 30 feet thick and consists of massive, coarse-grained sandstone. In Connellsville and Dunbar townships, the Conemaugh coals appear to be thin beds that are not persistent and have little value.

Monongahela formation. The Monongahela formation underlies the extreme western section of Connellsville Township and the western third of Dunbar Township, where the outcrop extends unbroken across the Uniontown syncline at the Youghiogheny River and then splits southwestward into two relatively narrow belts, one on each side of the synclinal axis. The entire formation is exposed in Dunbar Township, where it has an average thickness of 350 feet. At the base the three main divisions of the Pittsburgh coal with combined thickness of 10 to 14 feet are persistent. They are overlain by approximately 65 feet of drab to dark shale, sandy shale and sandstone. This interval, which contains the thin, irregular Pittsburgh Rider coal, becomes decidedly arenaceous along the west limb of the Uniontown syncline in contrast to the dominantly argillaceous character elsewhere in these townships. The Redstone limestone, from 10 to 20 feet thick, has a regular occurrence through the area and is the first persistent member above the Pittsburgh coal. It is overlain usually by the Redstone coal bed which is developed best in the eastern and southern parts of Dunbar Township. The Fishpot limestone exhibits its usual characteristics and is separated from the Redstone coal by a gray shale interval of variable thickness. Directly overlying the Fishpot limestone, the Sewickley coal bed is split into two and occasionally three beds by a sandstone and sandy shale lens that is between 20 and 50 feet thick through the area. The interval between the upper split of the Sewickley coal and the Waynesburg coal is composed chiefly of fresh-water limestone beds with a few thin beds of shale and sandstone. This interval does not have any persistent, recognizable horizons, but is made up of good developments of the Benwood, Uniontown, and Waynesburg limestone members that are not separable. The Uniontown coal bed has a local occurrence in the interval and lies about 290 feet above the base of the Pittsburgh coal. At the top of the formation, the Waynesburg coal is persistent through the area.

PERMIAN

From the meager amount of information available, it is not possible to correlate the strata of the Permian formation in the Uniontown-Connellsville basin with the named members of this formation that are recognized to the west in the Klondike district. In the two synclines, the Permian rocks appear to have entirely different characters and stratigraphic sequences, orders or intervals that cannot be carried across the intervening Fayette anticline. Possibly this anticline was present as a low ridge or barrier at the time of deposition and with the different conditions that probably existed in each basin, the deposits varied greatly in character on the two sides of the barrier. In the Uniontown syncline, Permian strata are dominantly drab to dark shales and sandy shales, and contain fewer limestone beds than in the Lambert syncline. Strata of this age have been entirely removed by erosion from Connellsville Township. They crop out in Dunbar Township in the middle of the Uniontown syncline, where the maximum thickness remaining uneroded is about 325 feet in the hilltops just northeast of Monarch (Ie). The Cassville member, lying above the Waynesburg coal, is persistent through the area as a dark to drab shale and clay shale. Along the outcrop, the Waynesburg sandstone was observed to be persistent as a thin- to heavy-bedded, medium-grained, slabby sandstone. This member is overlain by a series of three thin coal beds generally separated from each other by 10 to 35 feet of shale or sandy shale. The coals may represent a triple split of the Waynesburg A bed or more possibly both the Waynesburg A and B coals of the Lambert syncline. They are persistent and are overlain by a thin- to heavy-bedded, drab to gray sandstone that attains thicknesses of 50 feet. Above this sandstone the remaining Permian strata consist of a heterogeneous series of dark to drab shale and sandy shale with a few thin sandstone and fresh-water limestone beds and numerous thin coal beds of irregular occurrence. Correlation of these beds is not attempted.

PLEISTOCENE

Carmichaels deposits. Large areas of Carmichaels deposits occur near Connellsville and New Haven (Jd) along the Youghiogheny shortly after the river emerges from the gorge through Chestnut Ridge. These deposits lie from 75 to 175 feet above the present water level and consist of clay, sand, gravel and boulders usually jumbled together but in some places occurring as irregular lenses. Definite thicknesses are not known, but they are believed to be substantial. A second and smaller area of Carmichaels deposit was observed near East Liberty (Ic) in the northwest corner of Dunbar Township.

RECENT

Alluvium. Alluvial deposits of clay, sand and gravel occupy the present flood plain and remnants of the low terraces along the Youghiogheny River.

Coal Resources

The Pottsville coals, Quakertown and Mercer, do not attain mineable thicknesses in Connellsville and Dunbar townships. The Quakertown coal occurs as thin, non-persistent lenses of small lateral area and the Mercer coal, although persistent, is too thin and dirty to have any commercial value.

In the following tables of coal intervals, those applying to Allegheny coals refer only to the abnormally thin section of the formation

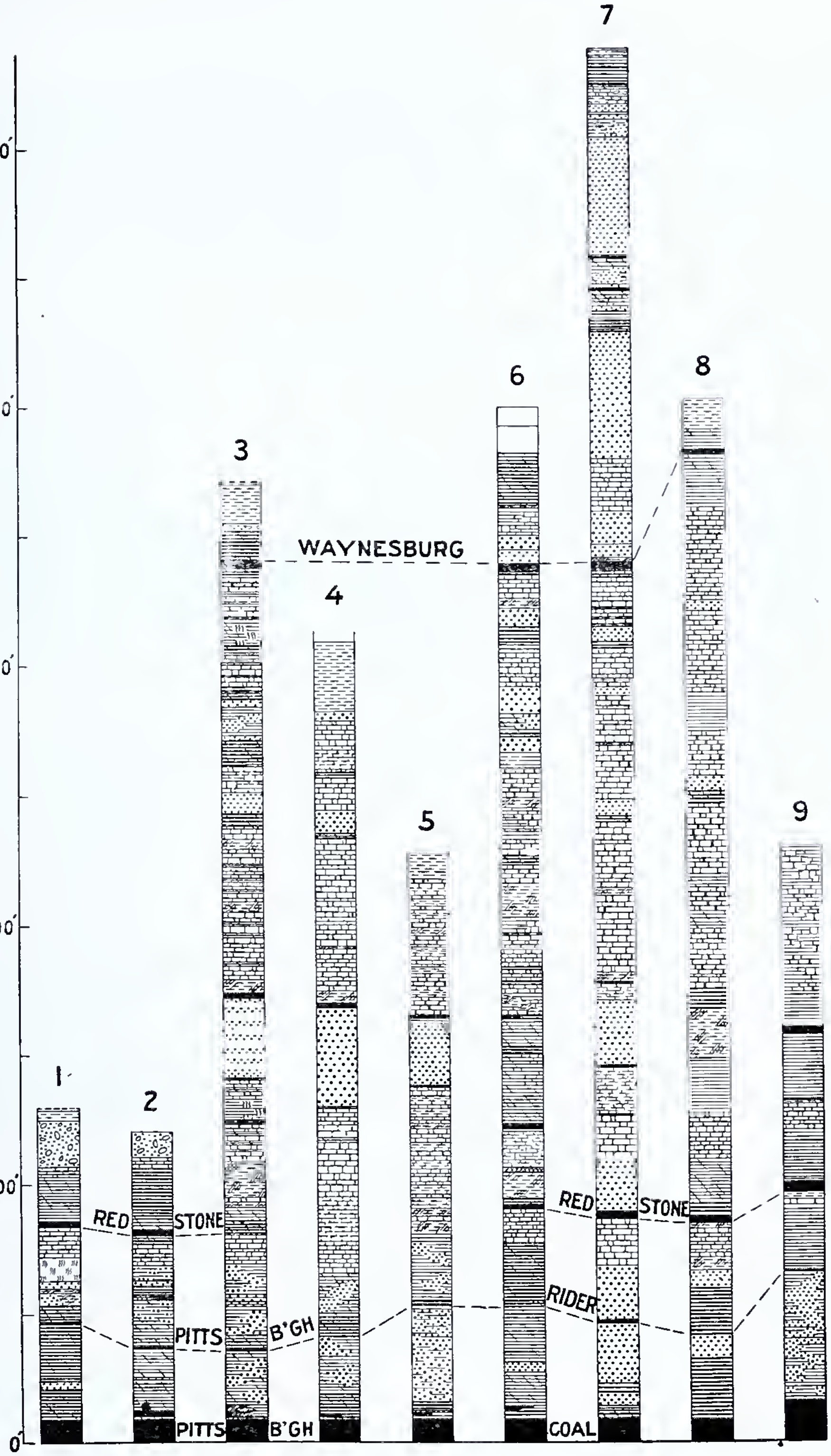

Figure 92. Stratigraphic sections of the Monongahela formation in Connellsville and Dunbar Townships.

1. Davidson shaft; H. C. Frick Coke Co. (Jda).
2. Diamond drill hole; H. C. Frick Coke Co. (Jd3).
3. Leisenring No. 1 shaft; H. C. Frick Coke Co. (Ie1).
4. Mayer shaft (He9).
5. Juniata shaft; H. C. Frick Coke Co. (He8).
6. Leisenring No. 2 air shaft; H. C. Frick Coke Co. (He6).
7. Leisenring No. 3 shaft; H. C. Frick Coke Co. (Ie2).
8. Hill Farm drill hole; American Manganese Manfg. Co. (Ie7).
9. Section near Hill Farm mine (Ie9) as measured by J. J. Stevenson; Second Pennsylvania Geol. Survey, Report KK, p. 179.

along its line of outcrop in the foothills on the west side of Chestnut Ridge. Data are not available on these coals in the normal section of the Allegheny formation occurring in the region west of Chestnut Ridge and the extreme east corner of Dunbar Township.

Allegheny coal intervals to top of Upper Freeport coal in Connellsville and Dunbar Townships, in feet

Coal	Average	Range
Upper Freeport (top)	0	0
Lower Freeport	50	35 to 60
Upper Kittanning (?)	90	80 to 95
Lower Kittanning	105	100 to 125
Brookville-Clarion	155	150 to 175

Intervals between the coals of the Conemaugh formation are not listed, as these coals were thin and valueless wherever observed. The interval between the top of the Upper Freeport coal and the base of the Pittsburgh coal averages 640 feet or the thickness of the Conemaugh formation.

Monongahela coal intervals to base of Pittsburgh coal in Connellsville and Dunbar Townships, in feet

Coal	Average	Range
Waynesburg (top)	350	335 to 365
Uniontown	290	290 to 295
Upper Sewickley	165	150 to 175
Lower Sewickley	130	115 to 140
Redstone	85	80 to 90
Pittsburgh Rider	45	40 to 50
Pittsburgh	0	0

ALLEGHENY COALS

The Allegheny coals underlie a narrow belt along the foothills on the west side of Chestnut Ridge and on the east slopes of the same mountain from Paul Flats to the east corner of Dunbar Township. In the area the more important coals of this age are the Lower Kittanning and Upper Freeport beds. Little is known concerning the character of the Allegheny coals on the east slopes of Chestnut Ridge, but they are believed to be essentially the same as given in the discussion of the coals of Springfield Township.

Brookville-Clarion or A coal. A coal crops out at numerous localities and apparently is persistent. The greatest thickness observed (Je5) was 17 inches along the Youghiogheny River. It has not been mined in these townships and is of doubtful value as a reserve.

Lower Kittanning or B coal. The Lower Kittanning coal is persistent and is believed to have a mineable thickness throughout Connellsville and Dunbar townships. It ranges from 22 to 50 inches and averages slightly under 36 inches thick. The bed is overlain by 10 to 20 feet of dark to drab shale that forms a very satisfactory mine roof, and underlain by 4 to 6 feet of gray clay which formerly was used to make bricks for beehive coke ovens. In Connellsville Township the coal averages about 40 inches thick, the top 2 to 10 inches being bony coal. The remainder of the bed is clean with the exception of some pyrite streaks and balls in the basal 6 inches. Around Dunbar the bed consists of clean coal from 20 to 35 inches thick. East and southeast of Ferguson the thickness increases to an average of 36 inches, but the bed contains one or two thin shale or clay partings near the base. The coal lying under these partings has numerous pyrite streaks and balls.

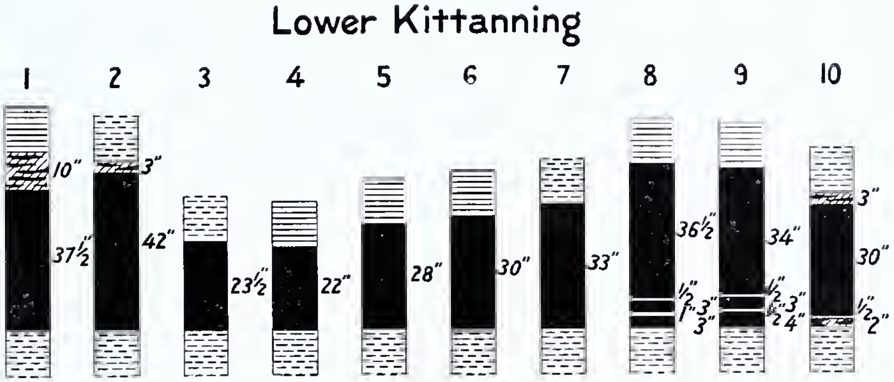

Figure 93. Sections of Lower Kittanning coal in Connellsville and Dunbar Townships.

1. Kd7. 2. Kd9. 3. Je4. 4. Je17. 5. Je22. 6. Je23. 7. Ke2. 8. Jf2. 9. Jf5. 10. Jf3, Palmer mine.

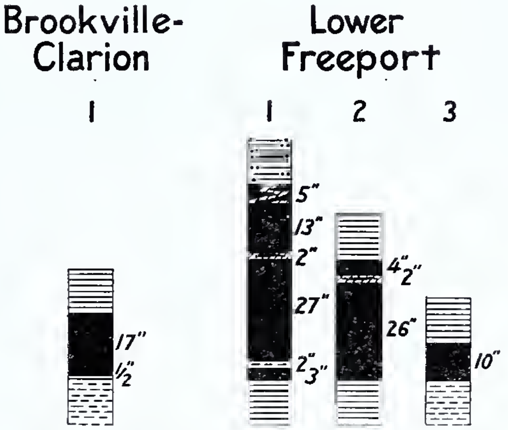

Figure 94. Sections of coals in Connellsville and Dunbar Townships.

Brookville-Clarion coal: 1. Je5.
Lower Freeport coal: 1. Je3. 2. Je13, American Manganese Company mine. 3. If3, Diamond drill hole.

Lower Freeport or D coal. The D coal is mineable in a small area east of Dunbar where it is from 30 to 48 inches thick. The coal is overlain by shale and sandy shale, and underlain by dark shale. It contains a bony layer up to 2 inches thick near the top of the bed and an occasional thin clay parting near the base. Balls of pyrite are common. Elsewhere in the area the Lower Freeport bed is a single bench of coal without partings, but less than 12 inches thick.

Upper Freeport or E coal. The Upper Freeport coal is persistent and mineable along its outcrop in Connellsville and Dunbar townships. Numerous openings supply custom or house coal, and several commercial mines have operated on this coal in the past. The bed, where not disturbed by the overlying Mahoning sandstone, is from 30 inches to 11 feet thick, with an average of about 54 inches. The bed is usually multiple benched. A top layer of bone coal from 1 to 10 inches thick is underlain by the main body of the bed, which is split by one or two binders from 1 to 3 inches thick. The upper binder near the middle of the bed is usually bone coal and the second binder near the base is gray clay. Pyrite balls and shale streaks are rather common in some localities. Several clay veins from 6 inches to 10 feet thick are reported to cut through the coal from bottom to top. The rolling floor is a soft plastic clay from 3 to 5 feet thick, and the normal roof is gray clay shale from 0 to 15 feet thick. This roof tends to soften when exposed and is said to be difficult to support. It is overlain by the heavy-bedded Mahoning sandstone that was observed at several places to roll down and replace all the roof shale and part or all of the coal bed. These so-called "sandstone faults" may have widths up to 100 feet and may cut out large areas of the coal. In the past, Upper Freeport coal from the Furnace Nos. 1 and 2 mines (Je12, Je21) was washed in a processing plant and made into coke in the old by-product coke ovens on Dunbar Creek. Although it produced satisfactory coke, the operation has been abandoned for some time and the plant and ovens dismantled.

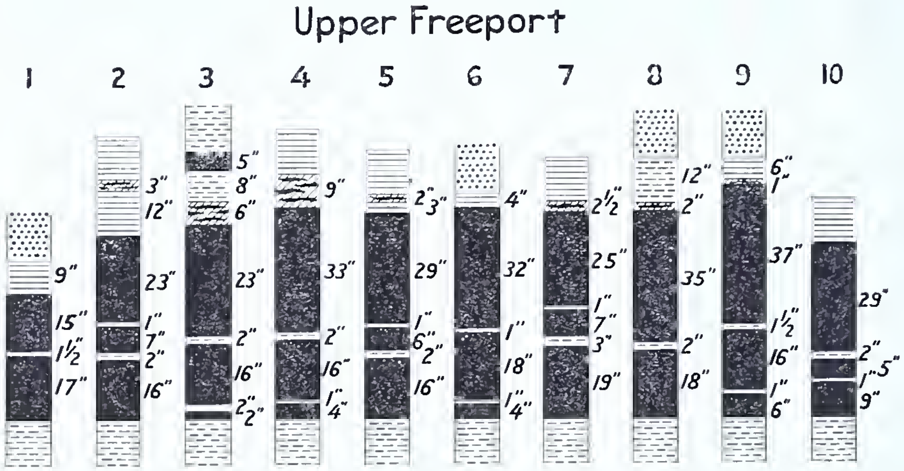

Figure 95. Sections of Upper Freeport coal in Connellsville and Dunbar Townships.

1. Kd8. 2. Kd10. 3. Jf1. 4. Je1, Walnut Hill mine. 5. Je2, Hurd mine. 6. Je12, Furnace (Freeport) No. 1 mine. 7. Je14. 8. Je15. 9. Je21, Furnace (Freeport) No. 2 mine. 10. Ke1.

MONONGAHELA COALS

The Monongahela coal beds underlie the western parts of Connellsville and Dunbar townships, in the Uniontown-Connellsville basin, where the important Pittsburgh coal has been mined extensively. The other coal beds of this formation have only local importance in the area.

Pittsburgh coal. The Pittsburgh coal at the base of the formation is a very regular and persistent bed in the townships. It is overlain by a dark shale from 10 to 25 feet thick in all except the extreme western part of Dunbar Township, where, locally, sandstone directly overlies the coal. The three general divisions of the Pittsburgh bed are easily recognized through the area and have a total thickness between 12 and 18 feet. The roof coal or upper division is persistent and ranges from 3 to 5 feet thick. It is composed of coal and shale, interstratified to such an extent as to render this member valueless. This coal attains its greatest thicknesses along the east limb of the Uniontown syncline south of the Youghiogheny River. The overclay or main clay parting, which is known as ''draw slate,'' lies between the roof coal and the lower division. It is from 2 to 14 inches thick. In mining operations it separates easily from the roof coal, but tends to cling to the coal of the lower division. The lower or main division of the Pittsburgh coal, which comprises the mineable section, is from 8 to 10 feet thick. Generally the greater thicknesses lie east of the synclinal axis and south of the Youghiogheny River. The breast coal of the lower division is from 56 to 84 inches thick and is remarkably free from impurities. The only reported parting in this section occurs in a very limited area in the Nellie mine (Id9) as a shale lens from 2 to 8 inches thick near the middle of the breast coal. The bearing-in coal, from 3 to 6 inches thick, shows the usual thin section of coal, from 2 to 4 inches thick, bounded at the top and bottom by shale partings from ¼ to 1 inch thick. Locally either of these partings may be absent. The remainder of the lower division below the bearing-in coal is known as the bottom coal. In this section the subdivisions known as the brick and lower bottom coal cannot be separated. The bottom coal is 34 to 38 inches thick, contains no partings, and is very regular in occurrence. The floor of the Pittsburgh coal is a gray clay from 3 to 5 feet thick. Along the eastern outcrop south of the Youghiogheny River, this underclay contains an appreciable percentage of iron in the form of siderite. In the past the siderite was mined for use in local blast furnaces. The normal occurrence of the Pittsburgh coal bed is disturbed at only one place in the area. In the Leisenring No. 2 mine (He7) a ''rock fault'' is reported to cut out about 40 acres of coal. This phenomenon is probably similar to the sandstone-filled erosion channels that are described in the discussion on Springhill Township.

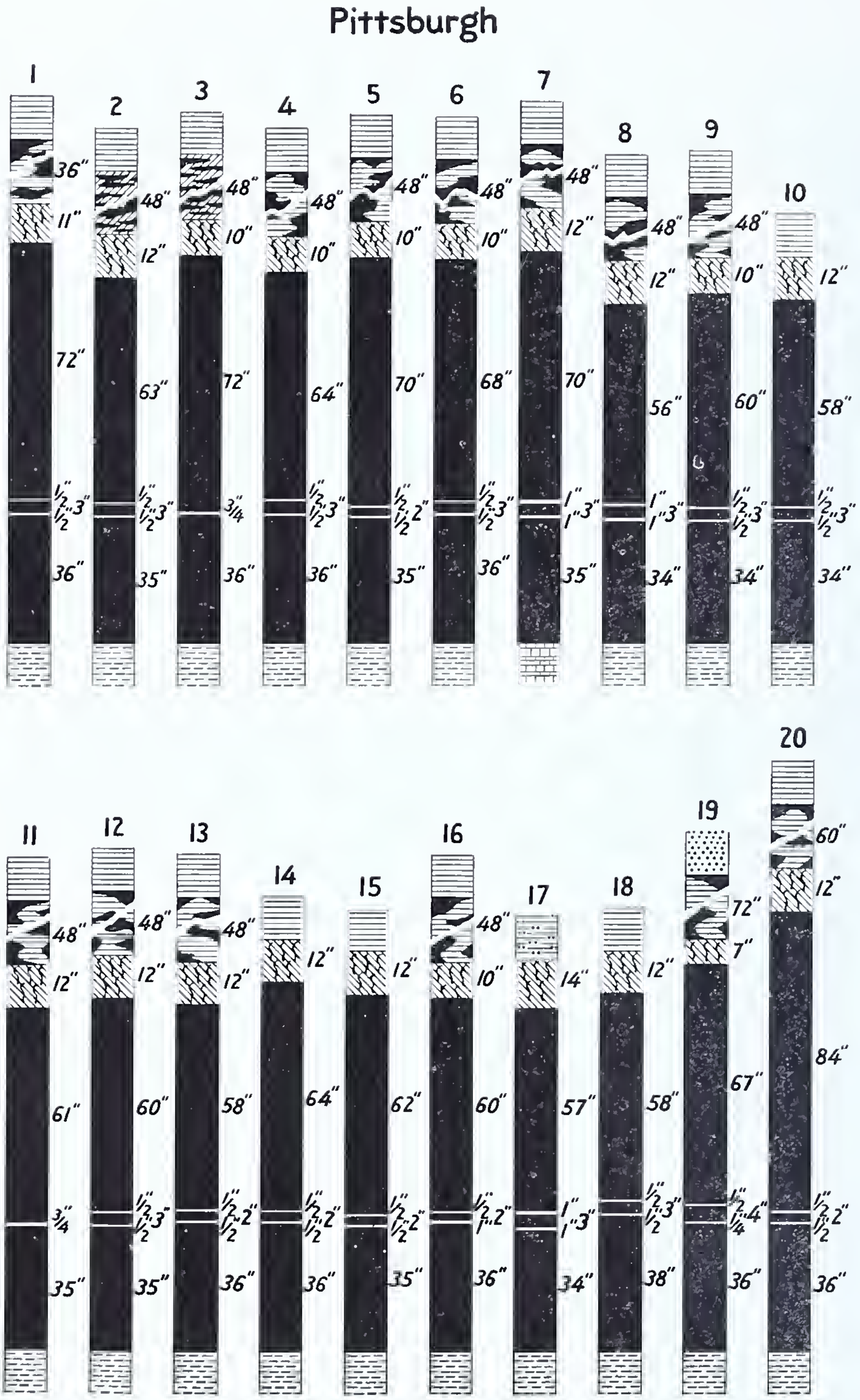

Figure 96. Sections of Pittsburgh coal in Connellsville and Dunbar Townships.

1. Jc18, Henry Clay mine. 2. Jd2, Davidson mine. 3. Jd6, Trotter mine (west side). 4. Jd6, Trotter mine (east side). 5. Jd7, Blackstone mine. 6. Id3, Adelaide mine. 7. Id5, Fort Hill mine. 8. Id7, Paul mine. 9. Id9, Nellie mine. 10. Ic8, Liberty mine. 11. He7, Leisenring No. 2 mine (east side). 12. He7, Leisenring No. 2 mine (west side). 13. He8, Juniata mine. 14. Ie1, Leisenring No. 1 mine (west side). 15. Ie1, Leisenring No. 1 mine (east side). 16. Ie2, Leisenring No. 3 mine (north side). 17. Ie2, Leisenring No. 3 mine (south side). 18. Ie9, Hill Farm mine. 19, Ie10, Ferguson mine. 20. Je6, Morrell mine.

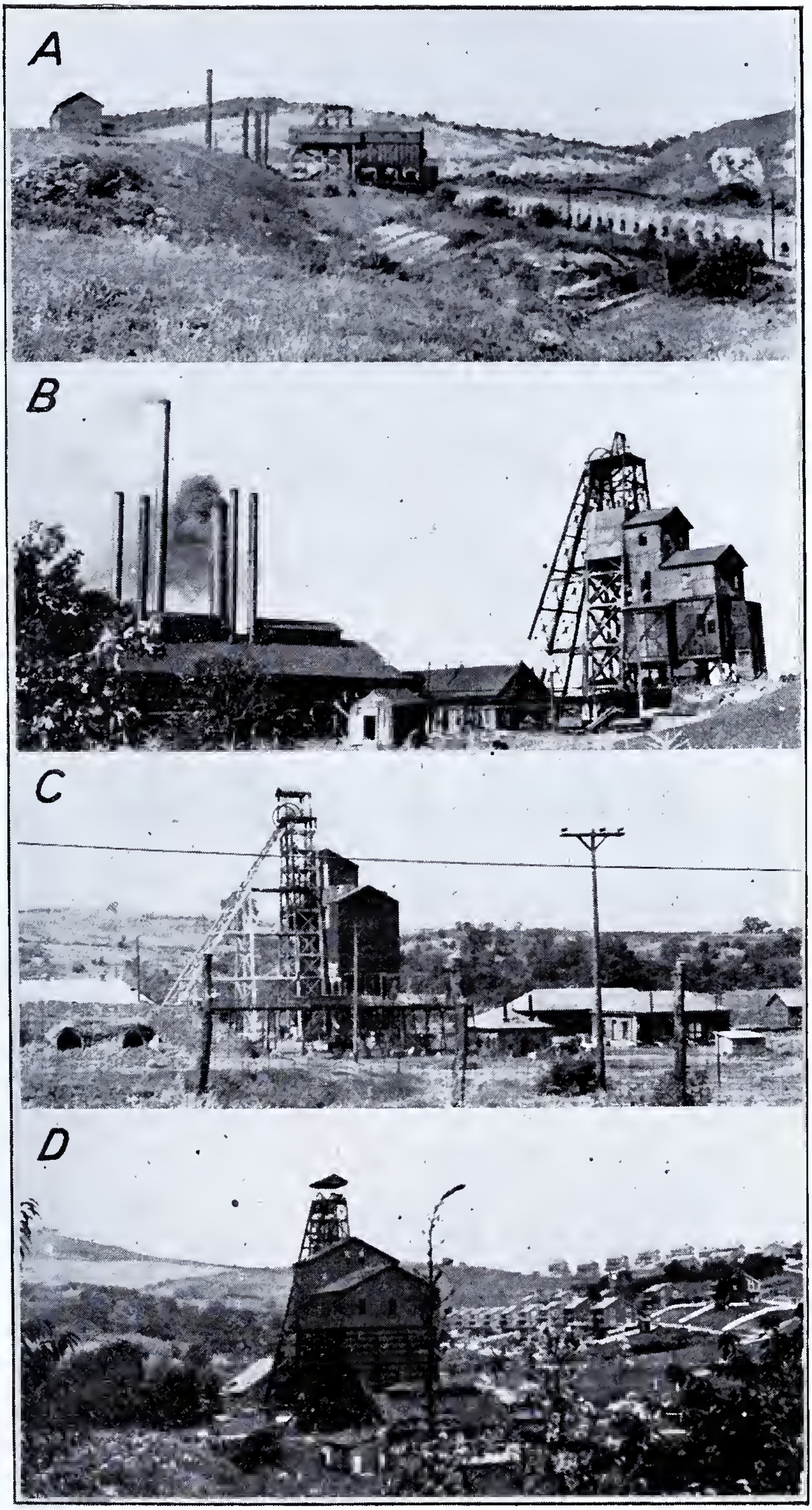

Figure 97. Headframes and tipples of mines in the Pittsburgh coal.

A. Leisenring No. 2 B. Trotter C. Buffington D. Ralph

Redstone coal. The Redstone coal bed lying 80 to 90 feet above the base of the Pittsburgh coal has a fairly persistent occurrence through these townships. Its best development is attained through the middle and on the east limb of the Uniontown syncline. Generally the thickest sections were observed at Hill Farm (Ie), where the bed is from 3 to 4 feet thick. This thickness decreases slightly to the north and the coal is from 20 to 30 inches thick in Connellsville Township. West of the axis of the Uniontown syncline the thickness decreases rapidly and the bed is frequently missing in the section along the western outcrop. Where observed in the area, the Redstone coal consists of hard, bright, dirty coal with one or more local clay binders that may have a large lateral extent. The floor and roof of the coal are usually gray plastic clay which separates the coal from the underlying and overlying limestone. Clay veins up to 10 feet thick that originate in either the top or bottom clay cut through the Redstone coal bed.

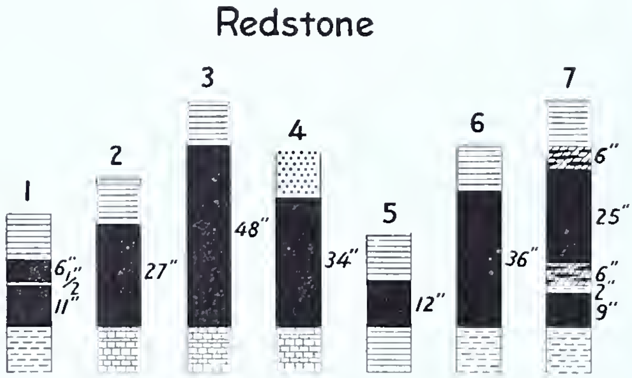

Figure 98. Sections of Redstone coal in Connellsville and Dunbar Townships.

1. Jc19. 2. Jd2, Davidson shaft. 3. He6, Leisenring No. 2 air shaft. 4. Ie2, Leisenring No. 3 shaft. 5. Ie4. 6. Ie7, Hill Farm drill hole. 7. Ic4.

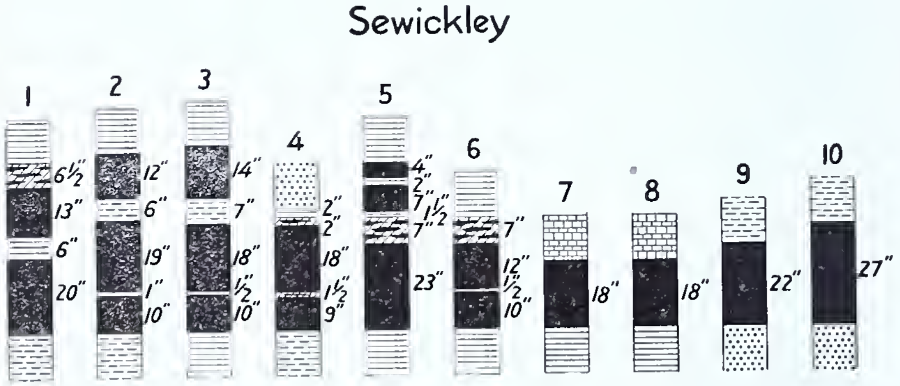

Figure 99. Sections of Sewickley coal in Connellsville and Dunbar Townships.

Lower Sewickley coal: 1. Jc16. 2. Jc17, Long mine. 3. Jc20, Rist mine. 4. Jc22, Abhrams mine.

Upper Sewickley coal: 5. Jd1. 6. Jd5. 7. He6, Leisenring No. 2 air shaft. 8. He8, Juniata shaft. 9. He9, Mayer shaft. 10. Ie1, Leisenring No. 1 shaft.

Sewickley coal. The Sewickley coal in Connellsville and Dunbar townships is split into two and sometimes three beds by an interval of sandy shale and sandstone. The middle bed is thin and has a sporadic occurrence. The Lower Sewickley lies from 115 to 140 feet above the Pittsburgh coal. It is persistent but reaches mineable thicknesses only in Connellsville and northern Dunbar townships. Here it is from 30 to 50 inches thick and contains two clay binders that split the bed into three nearly equal sections. The lower clay parting is from ½ to 1 inch thick and the upper has an average thickness of 6 inches. Elsewhere in the area this coal has reported thicknesses of 24 inches or less. The Upper Sewickley coal lies between 150 and 175 feet above the Pittsburgh coal and from 20 to 50 feet above the Lower Sewickley bed. In these townships, the Upper Sewickley coal is from 18 to 48 inches thick. Where observed, the lower half of the bed consists of clean coal and the upper half of dirty coal with one or more thin clay partings. This bed appears to increase in thickness to the south and east on approaching the south boundary of the area.

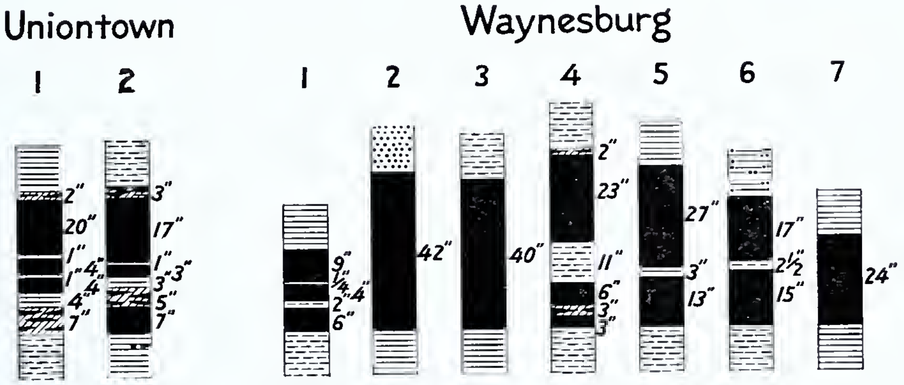

Figure 100. Sections of coals in Connellsville and Dunbar Townships.

Uniontown coal: 1. 1d10. 2. Id11.

Waynesburg coal: 1. Jd4. 2. He6, Leisenring No. 2 air shaft. 3. Ie2, Leisenring No. 3 shaft. 4. Ie3, Hairre mine (entrance). 5. Ie3, Hairre mine (face main heading). 6. Ie6. 7. Ie7, Hill Farm drill hole.

Uniontown coal. Lying about 290 feet above the base of the formation, the Uniontown coal occurs irregularly through the area as lenses. It has mineable thickness in a small area about 2 miles south of Vanderbilt (Id). Here the bed is 40 to 45 inches thick. The upper half contains numerous knife-edges of shale and the lower half is composed of several benches of dirty coal separated by two or three partings of shale or clay.

Waynesburg coal. The Waynesburg coal is a persistent bed lying 335 to 365 feet above the base of the Pittsburgh coal. It is generally a double-benched bed from 20 to 50 inches thick, overlain by 0 to 20 feet of dark to gray shale and clay shale. This shale is overlain in turn by drab, thin- to heavy-bedded sandstone. Gray shale and plastic clay underlie the coal bed. The upper bench of coal from 13 to 27 inches thick contains only moderately clean coal, as thin lenses of slate and bone and pyrite balls are fairly numerous. A clay parting from 2 to 12 inches thick separates the upper and lower coal benches. The lower bed is from 6 to 15 inches thick and consists of dirty to bony coal. In the mine shafts in the center of the syncline, the Waynesburg coal is reported as a solid bench of coal, but all field observations of the bed along its outcrop show the double-benched character described above.

PERMIAN COALS

The Permian coals are poorly exposed and little is known concerning their character and occurrence. From scattered observations, it is believed that they are thin, dirty coals of no value and that they occur irregularly as lenses. The maximum thickness observed on these coals, which crop out only near the center of Uniontown syncline, was 15 inches. Correlation of the outcrops of the coals of this age is not attempted.

Clay and Shale

Fire clays of the Allegheny formation crop out along the western foothills of Chestnut Ridge where several of them have been worked commercially in the past. The Lower Kittanning underclay ranges from 2 to 10 feet thick along its outcrop and consists usually of good-quality, gray, plastic fire clay. It was worked commercially at several localities in Connellsville Township. In Dunbar Township an active operation (If1) east of Mt. Braddock mines shows an average thickness of 6 feet of the Lower Kittanning underclay. The overlying coal is mined in the same operation for fuel. Other Allegheny fire clays formerly mined are the Bolivar flint clay (up to 8 feet thick) and the Lower Freeport underclay, which attains local thicknesses of 12 feet. The only Conemaugh clay worked in these townships is a flint clay that is tentatively correlated with the Middle Mahoning horizon. This bed containing flint clay of good quality is worked in an active operation (If2) east of Mt. Braddock. Detailed descriptions, and physical, burning, and chemical tests of these several clays will be found in the general discussion on clay and shale. The exposed shales in these townships have not been tested or developed commercially, but many of them would probably be suitable material for ordinary building brick.

Limestone

The Loyalhanna limestone cropping out along the sides and near the crest of Chestnut Ridge is from 55 to 65 feet thick in Connellsville and Dunbar townships. It has been quarried commercially in large operations for a long time in the gorges of the Youghiogheny River and Dunbar Creek, where it is rather accessible and close to transportation. The large plant (Ke4) operating at Casparis began as a quarry, but in recent years has been changed into an underground mine. The other active plants on this bed in the area are all quarry operations. The principal use of the product is for concrete aggregate or as road metal or railroad ballast. A special use is as paving block, for which purpose it is very satisfactory, as exemplified by its use in the shoulders and gutters along the National Pike on the west side of Chestnut Ridge.

The Greenbrier limestone lying 40 to 80 feet above the Loyalhanna formation is from 10 to 20 feet thick through the area. It has been opened at several localities for agricultural limestone and road metal. The limestone shows its usual blue-gray color and is highly fossiliferous. The basal section consists of 10 to 15 feet of massive-bedded limestone which is overlain by interbedded limestone and gray shale.

Limestone beds of Allegheny and Conemaugh age have not been opened in these townships and they are probably too thin and impure to have any value. In the Monongahela formation, the Redstone, Fishpot, Benwood and Waynesburg limestone beds have been worked in the western part of the area in small quarries to satisfy very local demands for agricultural limestone and road metal. These beds are all dense, hard, more or less impure, fresh-water limestone. The limestone beds of Permian age have not been worked, as they are thin and have an irregular occurrence.

Detailed description of the quarries and physical tests and chemical analyses of most of the limestones in Connellsville and Dunbar townships will be found elsewhere in the report in the general discussion on limestone.

Sandstone

The most important sandstone resources in these townships are the Connoquenessing and Homewood members of the Pottsville formation. They have been opened in several quarries and one mine on Chestnut Ridge along the Youghiogheny River and Dunbar Creek, where 40 to 50 feet of the Upper Connoquenessing sandstone and about 60 feet of the Homewood sandstone have been worked. Both formations are composed of light buff to white, coarse-grained, heavy-bedded sandstone. The material quarried is used for glass sand, refractory sand, road metal and building stone. Generally the Homewood sandstone is more suitable for glass sand than the Connoquenessing member, but both must be washed for use in the better grades of glass. Building stone obtained from these sandstones is very durable and entirely satisfactory.

West of Chestnut Ridge, quarries have been opened on the Saltsburg, Morgantown, Connellsville, Sewickley and Waynesburg sandstones. The product of these small quarries was used for road metal, beehive coke oven masonry, and building stone.

Detailed descriptions and physical tests of the various sandstone beds in the area are given in the county-wide discussion on sandstone resources.

Sand and Gravel

The sand and gravel resources of these townships are found along the Youghiogheny River in the present flood plain, low terraces, and the Carmichaels deposits. Pits have been worked along both banks of the river in Connellsville, West Connellsville and South Connellsville. The sand and gravel obtained were used chiefly for concrete and building construction. Most of the sand was suitable for building sand and some was sold for this purpose.

Oil and Gas

As the western parts of Connellsville and Dunbar townships lie in the Uniontown syncline and the eastern portions are in the relatively highly folded Chestnut Ridge area, the possibilities of commercial oil and gas production in the area are slim. Shallow test wells have been drilled west of Chestnut Ridge without success; the most favorable results were only shows of gas. Thus, the so-called shallow sands are practically eliminated as potential gas reservoirs in the area.

Gas production from the deep-lying Oriskany or other sands on Chestnut Ridge anticline is rather remote in Connellsville and Dunbar townships because of unfavorable structure. The crest of Chestnut Ridge anticline undulates through a low point in southern Dunbar Township from which it rises both to the northeast and southwest. If there were any gas in the deep sands, it would migrate away from this low to a high point on the axis. However, faults that cannot be located on the surface may be effective at the sand horizons in stopping such migration and may form pockets of gas. Such conditions are only bare possibilities and, at present, these two townships should be classed as unfavorable for oil or gas.

BULLSKIN TOWNSHIP

Bullskin Township lies in the northeast part of Fayette County and its approximate center is located in the map quadrilateral Lc. The slopes of Chestnut Ridge occupy the east half of the township and the west half lies in mature partially dissected upland known physiographically as the Kanawha section.

The area is drained by Jacobs Creek on the north township boundary and by Mounts Creek, which flows southwest through the center of the township. Jacobs Creek flows sinuously through a wide flat-bottomed, marshy valley, while Mounts Creek pursues a more direct course through its much narrower valley. Numerous tributaries to both streams have cut deep notches into Chestnut Ridge. The valley sides in the west part of the township rise gently 200 to 250 feet to rounded hilltops at 1,200 to 1,250 feet elevation. East from Mounts Creek the slopes rise to a line of knobs at 1,300 to 1,400 feet elevation and then continue rising to elevations of 2,100 feet on the crest of Chestnut Ridge at the east township boundary.

Two railroads have lines in this township, the Pennsylvania Railroad following Mounts Creek and Irish Run from Connellsville to Everson, and the Pittsburgh & West Virginia Railroad cutting across the southwest township corner.

Industries important in the past in this township were coal and clay mining, coke and brick making. Exhaustion of the Pittsburgh coal bed halted the coal-mining industry and the decline of beehive coking virtually stopped the clay mining and brick industries. At present custom coal is obtained from pillars in old mines on the Pittsburgh coal and from the Allegheny coal beds exposed on Chestnut Ridge. The Soisson Brick Company plant at Moyer (Kc) manufactures fire brick from flint and plastic clay of the Bolivar horizon mined at various places northeast of Moyer along Chestnut Ridge.

Structure

Two structure contour levels are used in Bullskin Township, a 20-foot contour interval on the base of the Pittsburgh coal and a 50-foot interval on the top of the Upper Freeport coal. The junction line of the two levels parallels Chestnut Ridge, passing ½ mile east of Moyer (Kc) and 1 mile west of Laurelville (Ma). Along this line the average interval between the two contour levels is 650 feet and hence the line may represent either the Pittsburgh bed 1,300-foot contour or the Upper Freeport bed 650-foot contour.

The Pittsburgh coal bed underlies the extreme western part of the township where the axis of the Uniontown syncline cuts across the southwest township corner. From this point, one mile west of Moyer, where it has an elevation of 880 feet, the Pittsburgh coal rises east to 1,080 feet altitude in 1 mile and northeast to 1,200 feet in 4 miles. Eastward from the axis of the Uniontown syncline the rate of rise of the rocks increases steadily from 200 feet per mile to a maximum of 1,000 feet per mile on the west flank of Chestnut Ridge anticline. As the anticlinal axis, which roughly parallels the east township boundary, is approached, the dip of the strata lessens considerably and the anticlinal crest is relatively flat and 1½ miles wide. East of the axis the strata dip gently eastward to the township boundary. The difference in structural elevation between the axes of the Uniontown syncline and Chestnut Ridge anticline, in Bullskin Township, is approximately 2,300 feet.

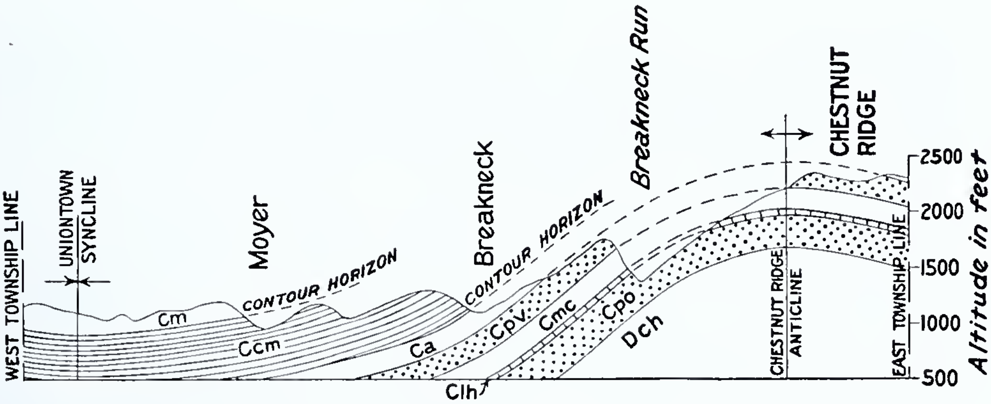

Figure 101. Structure section across Bullskin Township.

Legend: Cm—Monongahela formation; Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series; Dch—Post-Chemung and Chemung formations.

A structural low point or saddle occurs on Chestnut Ridge anticlinal axis ½ mile north of Stauffer School (Mb). From this low point, the axis rises 35 feet to the north township boundary and 255 feet southward to a structural high (Lc) 1½ miles south of Gerry School (Mc). South from this "high" the axis loses 60 feet in structural elevation to the south township line.

Abnormal dips in the vicinity of the reservoir (Lc) on Breakneck Run may indicate the presence of a fault. No other evidence was observed.

At this point it might be well to point out a discrepancy between the areal and structural geology as mapped in the spur (Lc and Mc) of Chestnut Ridge that lies between South Spruce and Spruce Runs, and east of Gerry (Mc) and Stauffer (Mb) Schools. Aneroid barometer elevations, Brunton compass directions, and pacing indicate that the topography of this spur is mapped 200-300 feet too high and may be located too far to the east. Hence the topography of the hill as shown on the map is disregarded and the geological formations are sketched on the spur in the manner in which they actually crop out.

Stratigraphy

The outcropping strata of Bullskin Township range in age from post-Chemung and Chemung of late Devonian time to Monongahela of late Pennsylvanian time. Approximately 1,900 feet of strata are exposed. The oldest rocks are exposed in the stream notches cut into Chestnut Ridge and the youngest in the southwest township corner west of Mounts Creek and Irish Run.

DEVONIAN

Chemung and post-Chemung. About 30 feet of Chemung and post-Chemung strata are thought to be above drainage as a small inlier (Ld) in Polecat Hollow near the south township line. The beds cannot be seen because of the heavy cover of talus.

MISSISSIPPIAN

Pocono series. The Pocono series is exposed in the upper valleys of Breakneck, Butler, Mounts and Green Lick Runs. The strata seldom crop out in Bullskin Township and their character is judged from float. The series has a thickness of approximately 300 feet and is composed of arenaceous sediments ranging from drab to white, medium- to coarse-grained, and medium- to massive-bedded. The small-sized float is usually drab and micaceous, and the large sizes are white or gray and often conglomeratic.

Loyalhanna formation. Where observed in Bullskin Township, the Loyalhanna formation has its usual gray, dense, siliceous character. This formation crops out in nearly all the notches cut by streams into the slopes of Chestnut Ridge south from Green Lick Run. Small exposures of the Loyalhanna were found in numerous localities, but nowhere was the entire thickness determinable. However, an assumed thickness of 50 to 60 feet may be considered representative; such thickness occurs in quarries a few miles south of Bullskin Township.

Mauch Chunk formation. The Mauch Chunk formation consists of red shales with minor amounts of green shale and green and drab micaceous sandstone. The Greenbrier limestone occurs as a persistent zone 50 to 70 feet above the base of the formation and is about 10 feet thick. This limestone has the characteristic blue-gray color and is very fossiliferous. Gray limy shale 1 to 3 feet thick directly overlies the limestone and is, in turn, overlain by red shale. The Mauch Chunk formation crops out near the crest and on the slopes of Chestnut Ridge. Its characteristic red soil and drab micaceous sandstone float are easily recognizable.

Exposures of this formation are limited to short stratigraphic sections, so that an approximate formational thickness of 200 to 250 feet is used in Bullskin Township.

PENNSYLVANIAN

Pottsville formation. The Pottsville formation caps the crest of Chestnut Ridge and in some places continues down the spurs of the ridge until the dip carries it under drainage in the foothills. This is beautifully illustrated in the spur (Kd, Ld) on the north side of Whites Run, of which a splendid view may be obtained from Lookout Point on the Springfield Pike (Route 711). In other places the outcrop continuity has been interrupted by an erosional break and the formation has been removed from below the ridge crest to well down in the foothills. Three members of the Pottsville formation were recognized in Bullskin Township; the upper or Homewood sandstone ranging from 85 to 100 feet thick; the middle or Mercer coals and shales of indeterminate thickness, but believed to be 30 feet thick; and the lower or Connoquenessing sandstone averaging 75 feet thick. In the Homewood sandstone member, the upper 20 feet is drab, medium-grained, slabby sandstone, and the lower 75 feet is drab and white, coarse-grained, heavy- and massive-bedded sandstone and conglomerate (pebbles up to ¾ inch). This sandstone member forms the cliffs and huge float, splendid examples of which may be seen in the vicinity of Bear Rock School (Nb). Coal of Mercer age was observed throughout the township, but only in the northeast corner was the coal found to attain mineable thickness. The road leading to the southeast from Ridgeview School (Mb) is in black and dark shales thought to be Mercer. This exposure, with other scattered ones, leads to the assumption that the Mercer group is chiefly brown to black, more or less fissile shales, with one or more coal and clay beds. The Connoquenessing member is usually concealed by Homewood talus, but where seen it is a medium- and heavy-bedded, medium- and coarse-grained sandstone. It presents a drab to buff slabby appearance and is not so weather resistant as the Homewood.

Allegheny formation. The Allegheny formation crops out on the slopes and foothills of Chestnut Ridge in the northern part of the township and only on the foothills in the southern part. Small outliers (Nb) occur on the crest of the ridge around Bear Rock School, and along the east township boundary the base of this formation is brought into the hilltops by the eastward dipping flank of Chestnut Ridge anticline. Exposures of Allegheny strata are poor in Bullskin Township and not a great deal is known concerning the character of these rocks. Intervals are indeterminable because of the steep dip where the formation is exposed. The thickness of the formation could not be determined in this township, but an assumed thickness of 150-175 feet is used. This subnormal thickness was obtained in the Youghiogheny gorge through Chestnut Ridge and is explained in the county-wide description of the Allegheny formation. The formation regains its normal thickness to the west before the Uniontown synclinal axis is reached, as is shown by the Bessemer drill hole (Ka1) given in the

Upper Tyrone Township discussion. Generally it may be said that the Allegheny formation is composed of drab and dark shale and sandy shale, with some sandstone beds chiefly between the Lower Kittanning and Lower Freeport coal beds. Locally a thin- to heavy-bedded sandstone appears just above the Brookville-Clarion coal. The Lower Kittanning-Lower Freeport interval shows numerous outcrops of sandstone and in places the middle and upper portions of this interval are known to be arenaceous. The Butler sandstone just above the Lower Freeport coal was found to be medium- to heavy-bedded and coarse-grained, but was not observed to exceed 25 feet in thickness. Immediately below the Upper Freeport coal a 25- to 35-foot interval is composed chiefly of clay representing the Upper Freeport plastic underclay and Bolivar flint clay. Important Allegheny clays are the Lower Kittanning underclay, Bolivar flint clay, and the Upper Freeport underclay. Mineable Allegheny coals are the Brookville-Clarion, Lower Kittanning, Lower Freeport and Upper Freeport beds.

Conemaugh formation. The entire thickness of the Conemaugh formation is found in Bullskin Township; its outcrop extends from the foothills of Chestnut Ridge to the west side of the valleys of Mounts Creek and Irish Run. Exposures are widely separated and each shows only a short stratigraphic section. However, from nearby sections and drill holes, the formational thickness is thought to average 650 feet. The Lower Mahoning sandstone is well developed as a heavy-bedded, coarse-grained, gray sandstone in all except the north part of the township, where it becomes an incompetent drab thin-bedded sandstone and sandy shale. The Middle Mahoning group is represented by the Mahoning coal of mineable thickness and a clay and clay shale series containing some limestone, iron ore and red shale beds. The Mahoning red beds are exposed in several localities in Mounts Creek valley, especially in the vicinity of Wooddale (Lb). From its float the Saltsburg sandstone is judged to be persistent and medium- to heavy-bedded. Red soil and occasional outcrops of red shale show the Pittsburgh and Birmingham red beds to be present. Along Mounts Creek in the southwest township corner good exposures of the Morgantown sandstone, Clarksburg group, and the Connellsville sandstone occur and measured sections are given in the general discussion of the Conemaugh formation. The only persistent mineable Conemaugh coal is the Mahoning, although the Upper Bakerstown coal may locally be important in the northern part of the township. The other Conemaugh coals wherever seen were all less than 12 inches thick. A detailed and complete Conemaugh section from the Bessemer core drill hole (Ka1), located just northwest of Bullskin Township, is given in the Upper Tyrone Township discussion.

Monongahela formation. The Monongahela formation comprises the youngest strata occurring in Bullskin Township, and occurs only along the western boundary and in the southwest township corner, where the maximum thickness remaining is not more than 250 feet. The Pittsburgh coal bed is at the base of the formation and ranges from 8 to 15 feet thick, including the roof coal. Overlying the Pittsburgh coal are 70 to 80 feet of drab and dark shale and sandy shale with local sandstone lenses up to 4 feet thick. The Pittsburgh Rider coal occurs in this interval about 40 feet above the formation base. Above the shale interval 10 to 15 feet of Redstone limestone was observed underlying the Redstone coal and clay which occur 80 to 90 feet above the Pittsburgh coal. Exposures above the Redstone coal are poor and scattered, but they indicate normal developments of the Fishpot and Benwood limestones and of the Sewickley sandstone.

Coal Resources

The Allegheny formation crops out on the slopes of Chestnut Ridge, where the strata are so steeply dipping and poorly exposed that intervals between coals cannot be accurately determined. Some fairly reliable intervals, measured in the field, agree closely with the intervals of the abnormally thin Allegheny section measured in the Youghiogheny River gorge through Chestnut Ridge. Hence, it is believed that the thin Allegheny section is continuous along the outcrop of this formation in Bullskin Township, but that the formation regains its normal thickness and intervals to the west before the Uniontown synclinal axis is reached. The following Allegheny coal intervals are for the thin section along the outcrop.

Intervals to Upper Freeport coal in Bullskin Township

Coal	Average	Range
Bakerstown (?)	240	240
Mahoning	65	40 to 75
Upper Freeport	0	0
Lower Freeport	50	40 to 60
Upper Kittanning	90	
Lower Kittanning	110	100 to 130
Brookville-Clarion	165	150 to 180
Mercer	245	220 to 255

Coals of Monongahela age are referred by interval to the Pittsburgh coal, which is the contour horizon in the west half of the township.

Intervals to Pittsburgh coal in Bullskin Township

Coal	Average	Range
Upper Sewickley	170	170
Lower Sewickley	125	125
Redstone	85	80 to 90
Pittsburgh Rider	40	30 to 45
Pittsburgh	0	0

POTTSVILLE COALS

Pottsville coal crops out on the crest and slopes of Chestnut Ridge and all observations are correlated with the Mercer coal, which is believed to be persistent in the township. In the northeast township corner the Mercer coal attains mineable thickness and has been opened for custom coal in several localities. The coal is overlain either directly or within 10 feet by heavy- to massive bedded, coarse-grained sandstone which locally cuts out the intervening shale and part or all of the coal bed. Because of this condition, the coal thickness varies considerably in short distances even so much as 0 to 40 inches. Where the coal is overlain by the normal dark gray to black shale, the thickness ranges between 24 and 40 inches. In all instances, "sulphur'' balls and lenses were observed scattered through the coal bed. The Mercer coal is not mineable in the remaining portion of the township and it was not observed over 12 inches thick. The Upper Freeport-Mercer interval was found to range between 220 to 255 feet.

ALLEGHENY COALS

The more important coals of Allegheny age are the Lower Kittanning and Upper Freeport, both of which are believed to be mineable throughout Bullskin Township. The Brookville-Clarion, Upper Kittanning, and Lower Freeport are locally of mineable thickness. The Allegheny coals are known only along their outcrop in the eastern part of the township.

Brookville-Clarion or A coal. On the slopes of Chestnut Ridge, the Brookville-Clarion coal has a persistent occurrence at an interval of 150 to 180 feet below the Upper Freeport coal. It is known to have mineable thickness in the central and southern parts of the township, though in the northern part the coal is only locally mineable. The coal is separated from the overlying Clarion sandstone, which is medium- and heavy-bedded, by 2 to 10 feet of drab and gray shale and sandy shale. South of Pleasant Valley School this coal is opened just north of Breakneck Reservoir (Lc12) and along Whites Run (Kd2). In both localities the bottom bench (7 to 10 inches of dirty coal) is separated from the upper bench (17 to 28 inches thick) by a shale or bone parting ½ to 1½ inches thick. The openings (Lc12) just north of Breakneck Reservoir show the top 5 to 8 inches of the upper bench as dirty or bony coal. North of Pleasant Valley School, scattered caved openings indicate a more variable thickness of coal, which observations limit between 9 and 24 inches. In Bullskin Township it might be generally said that the Brookville-Clarion is a hard, rather dirty and poor coal.

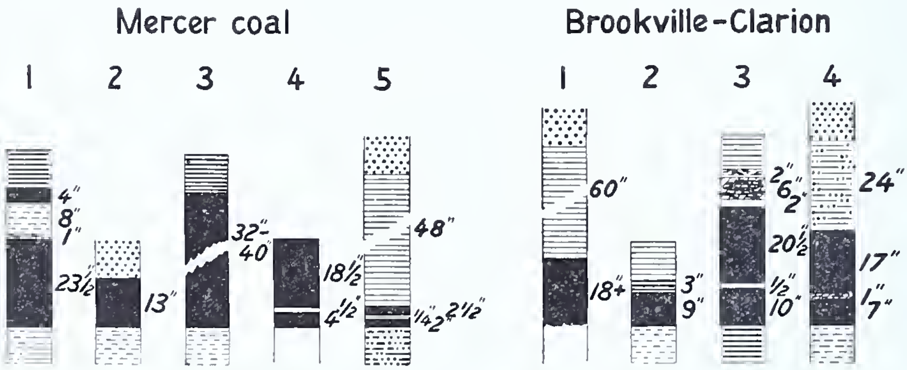

Figure 102. Sections of Mercer and Brookville coals in Bullskin Township.

Mercer coal: 1. Ma4. 2. Na2. 3. Nb4. 4. Mb2. 5. Lc14.
Brookville-Clarion coal: 1. Lb4. 2. Lc6. 3. Lc12. 4. Kd2.

Lower Kittanning or B coal. The Lower Kittanning coal in Bullskin Township is known only from observations along its outcrop on the slopes of Chestnut Ridge. It is a persistent coal and is known to be of mineable thickness along the outcrop south from Mount Vernon Park (Lb). It is not known how thick the coal is north of Mount Vernon Park, but a sizable coal crop (Ma5) ½ mile east of Laurelville indicates a good thickness. The roof of the coal bed is dark to gray shale 10 to 15 feet thick and the floor is usually plastic fire clay, although locally the immediate floor is 6 to 9 inches of flint clay. South from Mount Vernon Park to South Spruce Run (Lc), the Lower Kittanning coal ranges between 24 to 42 inches thick with the basal 8 to 14 inches showing either several bone partings or pyrite balls and streaks. Between South Spruce Run and the south township line, the coal ranges from 30 to 44 inches and appears to be all clean coal except the top 7 to 11 inches, which is bony coal. The Lower Kittanning coal along the outcrop is from 100 to 130 feet below the Upper Freeport coal or at an average interval of 110 feet. At present the coal is mined only for custom use, but it may have future commercial value in conjunction with the underlying plastic fire clay.

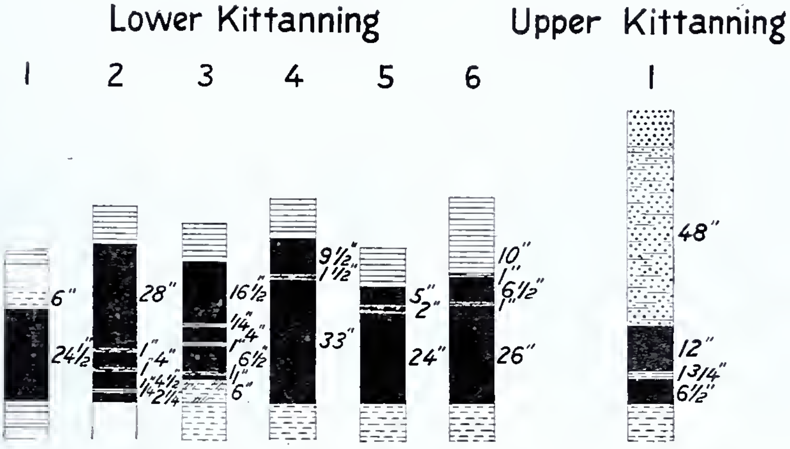

Figure 103. Sections of Kittanning coals in Bullskin Township.

Lower Kittanning coal: 1. Lb5. 2. Lc1. 3. Lc2. 4. Lc5. 5. Lc7. 6. Lc8.
Upper Kittanning coal(?): 1. Lb2.

Upper Kittanning or C′ coal. The Upper Kittanning coal was found in Bullskin Township at only one place. An opening (Lb2), one mile east of Mud School on Latta Run, showed the coal bed 20 inches thick with fire clay floor and shaly- to medium-bedded sandstone roof. This coal is tentatively correlated with the Upper Kittanning because of a poor interval determination of 90 feet to the Upper Freeport coal. An alternate correlation would be with the Lower Freeport bed.

Lower Freeport or D coal. The Lower Freeport coal was not observed in Bullskin Township, but two caved openings, one just north of the breast of Green Lick Reservoir and the other ¼ mile northeast of Mount Vernon Park, indicate a mineable thickness in that locality. The immediate roof of the coal is shale 4 to 8 feet thick overlain by medium- to heavy-bedded sandstone. This coal lies 40 to 60 feet below the Upper Freeport coal.

Upper Freeport or E coal. The Upper Freeport coal crops out along the slopes of Chestnut Ridge and is of mineable thickness wherever seen in Bullskin Township. It has been opened for custom coal or in conjunction with the underlying plastic and flint clay (Lc4) at numerous locations along its outcrop in the township. In its normal undisturbed occurrence, the coal bed ranges irregularly from 23 to 62 inches thick, with at least one but usually two gray clay or clay shale partings in the lower half. These partings may occupy as much as 20 inches of the total thickness, though usually they occuy less than 5 inches. Disregarding partings, the coal of the lower half of the bed appears cleaner than the coal of the upper half, which contains local bone binders (up to ½ inch) and knife edges of slate near the top. The floor is plastic fire clay and the normal roof is gray clay shale or shale which ranges from 0 to 15 feet in thickness and is overlain by heavy-bedded Mahoning sandstone. This roof shale has proved difficult to hold, as it softens and sloughs after exposure to air. The Mahoning sandstone was observed in many places to cut out all the intervening roof shale and part or all of the coal bed. The top of the Upper Freeport coal bed is used as the structure contour base in the east half of the township.

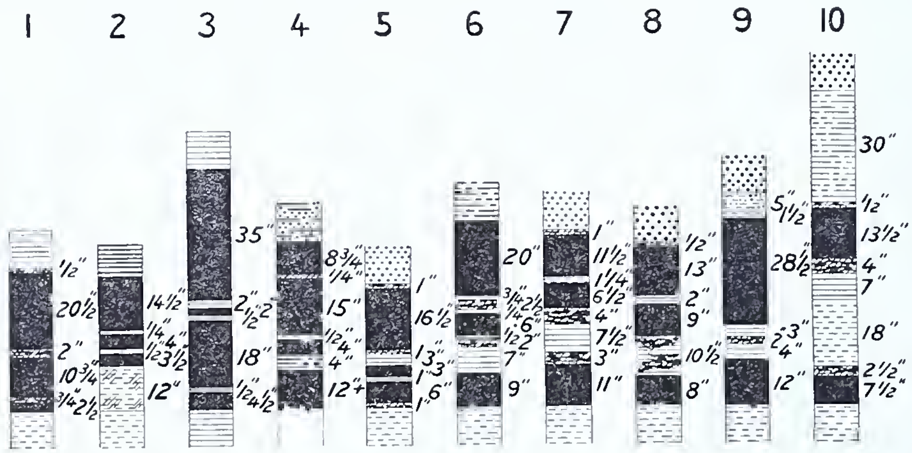

Figure 104. Sections of Upper Freeport coal in Bullskin Township.

1. Ma3. 2. Lb6. 3. Lb7. 4. Lb8. 5. Lb9. 6. Lc3. 7. Lc4. 8. Lc9. 9. Lc10. 10. Kd2.

CONEMAUGH COALS

Outcrops of Conemaugh coals were found at various points in the central and western parts of Bullskin Township. All the Conemaugh coals except the Mahoning and possibly the Bakerstown are thin (less than 10 inches thick) and not mineable.

Mahoning coal. The Mahoning coal has been mined for house coal at several points from Green Lick Run (Lb) south to Breakneck (Kc). Near Breakneck the bed is from 21 to 28 inches thick, of which the top 1 to 7 inches is coal and shale. North of Breakneck the coal is from 18 to 22 inches thick and averages 20 inches. The coal is hard and after exposure to the air it usually becomes coated with a white mineral which is probably a sulphate. Gray shale, 15 feet or more thick, forms the roof of the coal. The Mahoning coal lies 40 to 75 feet above the Upper Freeport.

Bakerstown coal. An opening north of the township along the Mount Pleasant-Somerset Pike is tentatively correlated with the Bakerstown coal. The coal is dirty and much broken by partings of clay and shale. This coal lies approximately 245 feet above the Upper Freeport coal.

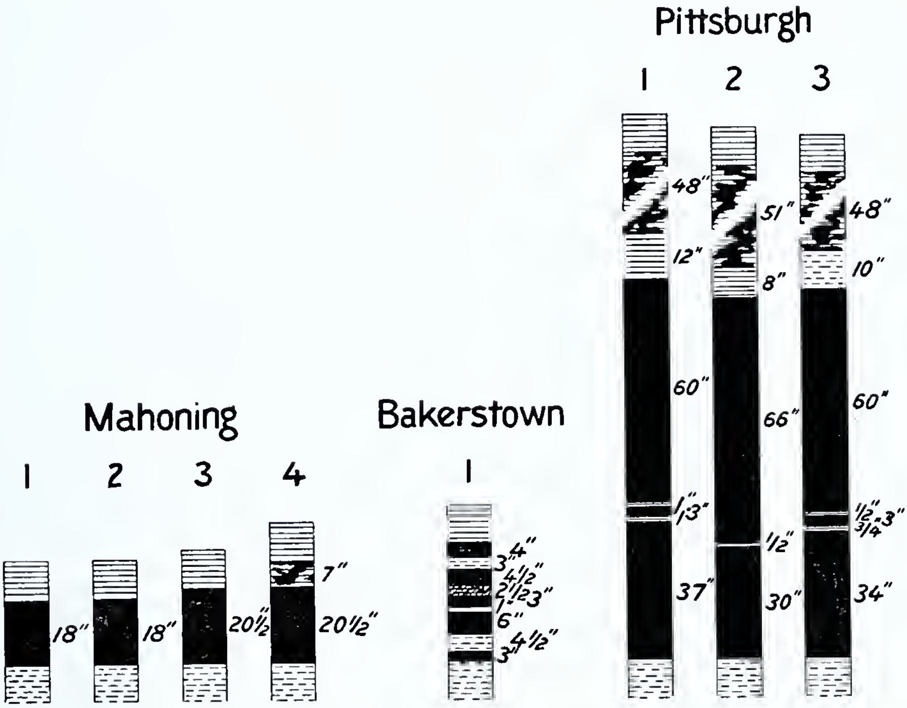

Figure 105. Sections of coal beds in Bullskin Township.

Mahoning coal: 1. Lb3. 2. Lc11. 3. Kc6. 4. Kc7.
Bakerstown coal: 1. Ma1.
Pittsburgh coal: 1. Kc1, Lawyer mine. 2. Kc3. 3. Kc4, Grace mine.

MONONGAHELA COALS

The Monongahela coals crop out in the southwest township corner and along the west boundary north to Jacobs Creek. The important Pittsburgh coal at the base of the formation has been mined out and the other coals are believed to have little value.

Pittsburgh coal. The Pittsburgh coal bed ranged from 12 to 13 feet in thickness and was a very regular bed consisting of three main divisions. The roof division averaged 4 feet of dirty coal with many shale partings, and was separated from the lower division by 8 to 12 inches of draw slate which comprised the main clay or shale parting. The lower division averaged 8 feet thick and was all excellent coal with the exception of the usual two shale partings at the bearing-in coal. In Bullskin Township the lower division of the Pittsburgh coal is subdivided into the bottom coal 30 to 37 inches thick, the bearing-in coal averaging 3 inches thick and the breast coal 60 to 66 inches thick at the top. The coal is reported to have been soft and easily mined. It was used for the manufacture of coke. No Pittsburgh coal remains in the township except small amounts along the outcrop and possibly in some old mine pillars.

Other Monongahela coals. Little is known of the Pittsburgh Rider, Redstone, and Lower and Upper Sewickley coals except that they are present. Outcrop observations indicate that they do not have mineable thickness in Bullskin Township. In the southwest township corner an abandoned opening (Je1), approximately 170 feet above the Pittsburgh coal, suggests a mineable thickness for the Upper Sewickley coal in that section.

Clay and Shale

When the region was an important coke manufacturing center, fire clays of Allegheny age, in Bullskin Township, were mined commercially for manufacture into coke oven brick. The Royal Brick Company and Jos. Soisson Fire Brick Company formerly operated mines ½ mile east of Mount Olive Church (Lc). The clay was obtained chiefly from the Bolivar flint clay bed, which is 10 to 15 feet thick (Lc4); minor amounts were obtained from the Lower Kittanning underclay. The Jos. Soisson Fire Brick Company also worked the Bolivar flint clay at other localities along its outcrop. The mined clay was transported to the company's plant at Moyer. Physical tests and analyses of the Bolivar flint clay (samples 26 and 403) and Upper Freeport plastic underclay (sample 404) are given in the chapter on clay and shale.

The Lower Kittanning underclay is reported to be about 5 feet thick in Bullskin Township and to have good qualities. An exposure in the coal opening (Lc2) east of Mount Olive Church shows 4 feet of plastic clay overlain by 4 to 8 inches of flint clay. The flint clay has a local occurrence.

The Soisson Fire Brick Company manufactures face brick from shales of the Lonaconing division of the Upper Conemaugh formation quarried at Moyer (Kc5). Sample 98 listed in the clay and shale chapter gives the results of physical tests on this shale.

Limestone

The Loyalhanna limestone crops out in the notches cut into Chestnut Ridge by Green Lick Run, Mounts Creek, South Spruce and Breakneck Runs. Exposures are poor and not much is known of this limestone in Bullskin Township. It exhibits the usual gray, dense, cross-bedded characteristics and is believed to be 50 to 60 feet thick.

The Greenbrier limestone lies 40 to 80 feet above the Loyalhanna formation and is persistent in the township, ranging from 10 to 15 feet in thickness. This limestone furnishes a good grade of agricultural lime and has been used for road metal. A small quarry (Lc15) 1½ miles southwest of Gerry School shows 12 feet of blue-gray fossiliferous limestone overlain by gray and red shale. Several quarries (Mb4, Mb5) were formerly opened near Stauffer School. The Harshman quarry (Lc13) on Breakneck Run shows 11 feet of blue-gray fossiliferous limestone overlain by red and gray shale and underlain by shaly limestone. The 11-foot massive limestone bed is quarried and burned for agricultural lime and was formerly used for road metal. In the general limestone chapter, sample F66 gives chemical and physical analyses of the Harshman quarry (Lc13) limestone and sample F65 lists physical tests on the limestone of the quarry (Lc15) southwest of Gerry School.

Little is known concerning the Allegheny and Conemaugh limestones, as they have not been opened. The Upper Freeport limestone was observed (Lc4) east of Mount Olive Church as a nodular bed up to 12 inches thick. The Clarksburg limestone of Upper Conemaugh age crops out (Kc5) in the bluff along Mounts Creek, near Moyer, and is a double bed with a 2-foot upper bench and a 3-foot lower bench separated by 3 feet of dark shale.

The Redstone and Benwood limestones of Monongahela age are persistent in the southwest township corner and have been opened for agricultural lime. A quarry (Kb1) one mile north of Pennsville has a reported thickness of 10 feet, of which the lower half was concealed by slumped material. The visible upper section shows, from top to bottom, 4 feet of dark gray limestone, 6 inches of gray shale, and 1 foot of dark gray limestone. This limestone bed lies 1 to 3 feet below the Redstone coal, which is reported 18 inches thick. Sample F63, under the general Redstone limestone discussion, lists the chemical and physical analyses on the upper 4-foot limestone bed in this quarry. Two quarries (Jc1, Jc2) 1½ miles west of Moyer are in the Benwood limestone. The limestone is hard, massive and dark gray. Six feet of limestone were exposed in quarry Jc2 and sample F60, in the general Benwood limestone report, lists the results of physical tests on this section.

Sandstone

Although many sandstones crop out in Bullskin Township, only three have been utilized. A quarry ¼ mile southeast of Pleasant Valley School (Lc) worked 15 to 25 feet of hard, gray, heavy-bedded Westernport sandstone for use as a stone base in roads. This Allegheny sandstone occurs just above the Lower Kittanning coal.

The Morgantown sandstone of the Upper Conemaugh was worked in a quarry (Lb1) ½ mile south of Hammondville. The quarry face shows 20 feet of massive, gray, micaceous sandstone. Sample F64 in the general Morgantown sandstone chapter shows the physical analyses and states that the sandstone is suitable for stone base in roads.

Several abandoned quarries in the Connellsville sandstone, in the vicinity of Pennsville (Kc) on the west side of Irish Run, were reported to have supplied construction material for beehive coke ovens. The rock in these quarries is a gray and buff, coarse-grained, heavy-bedded sandstone.

Oil and Gas

Some wells have been drilled for gas in Bullskin Township, but none found commercial quantities. The Anna Grimm No. 1 well (Nb6), on the crest of Chestnut Ridge anticline, the deepest test in the township, was a dry hole. The drillers' log[1] of this well is as follows:

Log of Anna Grimm No. 1 well on Chestnut Ridge

	From	To
Sand		83
Coal—Clarion	128	130
Sand	370	390
Lime—Big	395	437
Sand—Big Injun	437	971
Slate	971	981
Sand—Little gas at 1010	981	1038
Shale	1038	1105
Sand	1105	1125
Slate	1125	1165
Sand	1165	1190
Slate and shells	1190	1310
Sand—Murrysville	1310	1313
Slate and shells	1313	1410
Red rock	1410	1430
Red rock	1430	1565
Slate	1565	1575
Sand	1575	1605
Slate	1605	1648
Sand—Red	1648	1658
Red slate	1658	1705
Sand	1705	1728
Red rock	1728	1790
Sand—5th	1790	1833
White slate	1833	1854
Sand—Elizabeth	1854	1882
Slate	1882	1888
Sand	1888	1897
Slate and shells	1897	2573
Sand—Speechley stray	2573	2590
Slate and shells	2590	2640
Sand—Speechley	2640	2678
Slate	2678	2720
Sand	2720	2726
Slate and shells (Tiona 2800-2806)	2726	3165
Sand	3165	3181
Slate	3181	3225
Sand	3225	3235
Sand	3390	3398
Slate	3398	3438
Sand	3438	3470
Slate	3470	3485
Sand	3485	3525
Slate	3525	3530
Sand	3530	3580
Slate	3580	3653
Sand	3653	3686
Sand	3790	3800
Shells	3800	4108

Remarks: Show of Gas at 1010′—Water in Big Injun.
Casing: 13″ @ 25′—8″ @ 944′—6⅝″ @ 1749′.

This well is 21 miles north of the Summit well, South Union Township, Fayette County, and 15 miles south of the McCance well,[2] Ligonier Township, Westmoreland County. The three wells are all located on the Chestnut Ridge anticline.

SALTLICK TOWNSHIP

Introductory Statement

Saltlick Township occupies the northeast corner of Fayette County, with its approximate center in the map quadrilateral Oc. It extends across Ligonier Valley from the crest of Laurel Hill to the crest of Chestnut Ridge.

Indian Creek flows southwesterly across the township in a relatively flat valley ⅛ to ¼ mile wide. The valley sides rise rapidly to knobs and flat-topped hills from 1,900 to 2,100 feet above sea level. Farther from Indian Creek, elevations of 2,900 feet on Laurel Hill and of 2,100 feet on Chestnut Ridge are attained. The principal tributaries of Indian Creek are Back Creek, draining the east half of the township, and Champion Creek and Poplar Run, draining the west half.

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[1] Log furnished through courtesy of Carnegie Natural Gas Company.

[2] For correlation see Bull. M19; Pennsylvania Geological Survey, p. 50.

A branch line of the Baltimore & Ohio Railroad follows Indian Creek through the central part of the township and connects with the commercial coal mines. These mines are located at Indian Head, Sagamore, and Melcroft. At the time of field investigations they were the only active shipping mines working coal beds of the Allegheny formation in Fayette County.

Structure

Saltlick Township lies almost entirely in the Ligonier syncline. The synclinal axis passes northeast-southwest through the center of the township near Indian Head, Coffman and Roaring Run. On the east limb of the syncline the strata rise steeply and the Upper Freeport coal bed rises from a low of 1,525 feet elevation at Newells Gardens (Pc) to a theoretical high of 3,300 feet on the Laurel Hill anticlinal axis, in the northeast corner of the township, a distance of 4 miles. The strata of the west limb rise much more gently, the Upper Freeport coal attaining a theoretical elevation of 2,400 feet in the southwest corner of the township, a distance of 6½ miles from Newells Gardens.

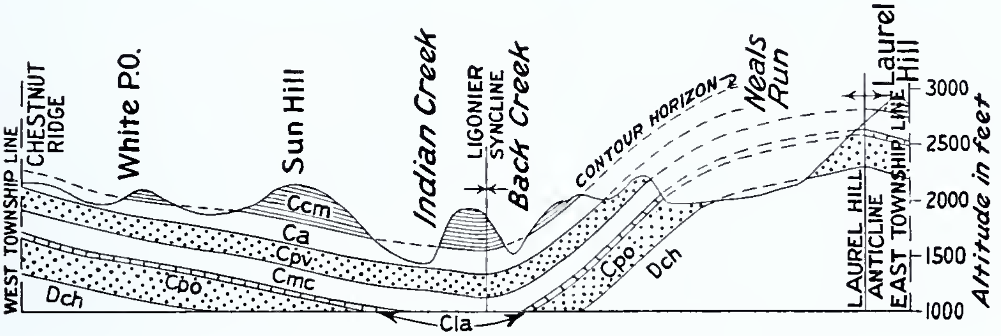

Figure 106. Structure section across Saltlick Township.

Legend: Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series; Dch—Post-Chemung and Chemung formations.

The axis of Chestnut Ridge anticline lies ½ to 1½ miles northwest of the west township boundary. Laurel Hill anticlinal axis cuts across the extreme eastern part of the township and loses approximately 100 feet of structural elevation in its southwest course.

The structure contour horizon in Saltlick Township is the top of the Upper Freeport coal bed and the contour interval is 50 feet.

Stratigraphy

The surface rocks of this township range in age from Chemung and post-Chemung of late Devonian time to Conemaugh of Pennsylvanian time. The oldest rocks are exposed on Laurel Hill and Chestnut Ridge, and the youngest in Ligonier Valley in the hills bordering Indian Creek.

DEVONIAN

Chemung and post-Chemung. Chemung and post-Chemung strata are figured by interval to crop out in the valleys of Trout and Neals Runs on the flank of Laurel Hill. These beds are covered by talus from the overlying formations and cannot be observed in the field. By interval, the maximum thickness exposed would be approximately 100 feet.

MISSISSIPPIAN

Pocono series. Little is known concerning the character and thickness of the Pocono series in this township, as the strata are seldom exposed. Judged from its float, the series is composed of arenaceous sediments, ranging from drab, micaceous medium-grained, medium-bedded sandstone to white, coarse-grained, heavy-bedded sandstone. The lower part evidently contains numerous conglomerate beds with white quartz pebbles up to ¾ inch. The series is believed to have an approximate thickness of 350 feet on the flank of Laurel Hill, in the valleys of Trout, Neals and Laurel Runs.

Loyalhanna formation. This siliceous limestone formation crops out on the slope and near the crest of Laurel Hill. It has the Loyalhanna characteristics, light gray, highly cross-bedded on weathered surfaces and medium gray, homogeneous, fine-grained, dense on fresh fracture. The top and bottom are not exposed in the township, so that the total thickness is unknown. Thicknesses of 30 to 35 feet were observed in the field.

Mauch Chunk formation. The Mauch Chunk formation consists chiefly of red shale with minor amounts of green shale and green to light brown micaceous sandstone. The Greenbrier limestone occurs 50 to 80 feet above the base of the formation and, though persistent, its greatest thickness observed was 6 feet. The Mauch Chunk formation is exposed on the crest and west flank of Laurel Hill, where it yields the characteristic red soil. Its contact with the overlying Pottsville formation was not observed in the field, so that only an approximate thickness range of 200 to 250 feet can be assigned to the Mauch Chunk.

PENNSYLVANIAN

Pottsville formation. The three members of the Pottsville formation, Connoquenessing sandstone, Mercer shale and Homewood sandstone, are not distinguishable in Saltlick Township. The hard and massive coarse-grained sandstone and conglomerate (pebbles up to ½ inch) at the top of the formation form cliffs 30 feet high and float conceals the underlying members. The Pottsville formation caps the crest of Laurel Hill and again crops out on the middle slopes of the same mountain, dipping steeply towards the Ligonier Valley. The formation is under drainage in the valley with the exception of a small inlier (NW corner of Oc) on Little Champion Creek, where about 30 feet of Homewood sandstone is exposed. Along the west township line the Pottsville again crops out and in the southwest township corner the entire thickness is exposed. The basal contact of this formation is concealed by talus and only an approximate thickness ranging between 150 and 225 feet has been used.

Allegheny formation. The Allegheny formation in Ligonier Valley is exposed along Indian, Back, and Champion Creeks. From the valley, it rises steeply towards Laurel Hill and passes out of the ground along the base of that mountain. West of Indian Creek, the Allegheny formation rises more gently and crops out in the stream valleys and on the slopes of Chestnut Ridge. The formation is dominantly drab and dark shale, with numerous lenses and beds of sandy shale and weak sandstone. A peculiar dark gray shale bed, about 20 feet thick, lying on the Lower Kittanning coal bed, is exposed along the road just north of the tipple of the Indian Creek Coal & Coke Company mine. The shale consists of even, thin, alternate bands of dark and light gray material, giving the exposure a varved appearance. The only persistent and notable sandstone member in the Allegheny formation is the Westernport sandstone, which may occupy the entire interval between the Lower and Upper Kittanning coals. This member ranges from drab shaly sandstone to heavy-bedded, coarse-grained (in places moderately conglomeratic) sandstone, with the upper part generally heavier than the lower. Another sandstone member, the Kittanning or Clarion sandstone, is locally heavy. The Johnstown and Upper Freeport limestones were observed in the field and they probably have a pockety occurrence. Allegheny coals of mineable thickness in Saltlick Township are Brookville, Clarion, Lower and Upper Kittanning, and the Lower and Upper Freeport coals. The Allegheny formation as shown in diamond drill holes ranges in thickness between 200 and 230 feet in Ligonier Valley, and, though no direct evidence is obtainable, the formation is assumed to be 150 to 175 feet thick on Chestnut Ridge. This assumption is based on the measured Allegheny sections on the west flank of Chestnut Ridge and given in detail in the stratigraphy of the Allegheny formation.

Conemaugh formation. This formation representing the youngest strata in the township caps the hills along Indian Creek and extends halfway up the slopes of Chestnut Ridge. The maximum thickness of the Conemaugh formation remaining in any hilltop is not more than 500 feet. Generally the Mahoning sandstone is weak or shaly, although locally it may become heavy-bedded and coarse-grained. The Saltsburg sandstone member is well developed and forms cliffs of light gray, coarse-grained, massive sandstone and conglomerate. Red shales were observed in a few localities and are tentatively correlated with the Meyersdale and Pittsburgh red beds.

Coal Resources

The following table of intervals is true only of the normal Allegheny thickness (210 feet) in Saltlick Township. On Chestnut Ridge, where it is assumed that the Allegheny section is abnormally thin (170 feet), the Upper-Lower Freeport interval is 50 feet, the Upper Freeport-Lower Kittanning interval is 105 feet, and the Upper Freeport-Brookville-Clarion interval is 170 feet.

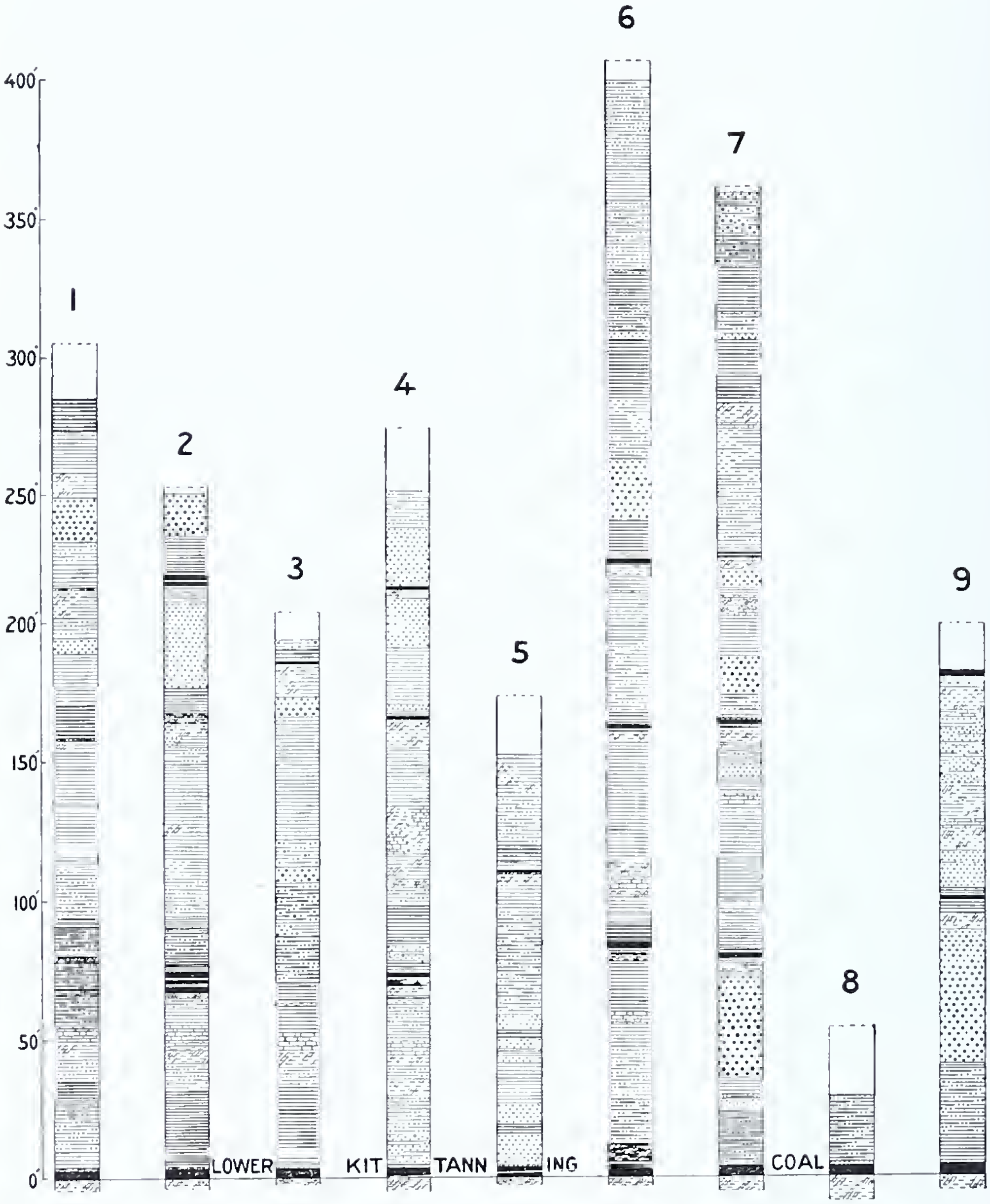

Figure 107. Stratigraphic sections in Saltlick Township.

DIAMOND DRILL HOLES

1. Indian Creek Coal & Coke Co., Ob3.
2. Indian Creek Coal & Coke Co., Ob1.
3. Indian Creek Coal & Coke Co., Oc13.
4. Indian Creek Coal & Coke Co., Oc2.
5. Indian Creek Coal & Coke Co., Oc12.
6. Sagamore Coal Co., Pc6.
7. Sagamore Coal Co., Oc11.
8. Sagamore Coal Co., Od2.
9. Indian Creek Coal & Coke Co., Oc7.

Normal intervals to top of Upper Freeport coal in Saltlick Township, in feet

Coal	Average	Range
Bakerstown	230	230
Mahoning	55	50 to 60
Upper Freeport	0	0
Lower Freeport	55	40 to 60
Upper Kittanning	90	80 to 110
Middle Kittanning	130	120 to 140
Lower Kittanning	155	140 to 170
Brookville-Clarion	210	200 to 225
Mercer	290	290

POTTSVILLE COALS

The Pottsville coals were not observed in outcrop in Saltlick Township. A series of caved openings (Mc3) ¾ mile west of Clinton are probably on the Mercer coal bed and they indicate a mineable thickness in that area.

ALLEGHENY COALS

The Brookville-Clarion, Lower and Upper Kittanning, and Lower and Upper Freeport beds are the mineable Allegheny coals in Saltlick Township. Of these, the Lower Kittanning is the only one mined commercially.

Brookville-Clarion or A coal. The Brookville-Clarion coal lies 200 to 225 feet below the Upper Freeport coal in the Ligonier Valley, but in the western part of the township this interval decreases to 170 feet. Its outcrop coincides with the Allegheny-Pottsville contact as shown on the map. This coal is persistent, but is believed to be thin and to have little value in the township. A prospect pit (Mc2) 1½ miles west of White P. O. shows 10 inches of coal overlain by 11 inches of clay and dark shale. In the diamond drill hole (Od2) ½ mile north of Indian Head, the bed is 23 inches thick, with a 2½-inch binder 7½ inches above the base. This is the greatest thickness reported or seen on the Brookville-Clarion coal in the township.

Lower Kittanning or B coal. The Lower Kittanning coal crops out on the lower slopes of Laurel Hill, and along Indian Creek from Indian Head to Melcroft, where the outcrop swings west along Champion and Little Champion creeks and is continuous to the western part of the township on the slopes of Chestnut Ridge. This bed lies 140 to 170 feet below the Upper Freeport coal in Ligonier Valley, but on the upper slopes of Chestnut Ridge this interval decreases to 100 to 120 feet. This coal is very persistent throughout the township and is of mineable thickness wherever seen, the thickness ranging from 2 to 4½ feet and averaging 3 feet 10 inches. The top of the bed invariably consists of 4 to 8 inches of laminated coal and black shale or bony coal. The remainder of the bed is clean coal, with the exception of a sporadic bone binder up to 4 inches thick that occurs 15 to 22 inches below the top of the bed. This middle bone binder is of common occurrence around Indian Head and where absent its position is often indicated by pyrite balls and lenses. In the basal 6 inches of the bed, pyrite balls and knife-edges of slate occur. The floor of the coal bed is fire clay and the roof is usually dark gray shale from 0 to 25 feet thick. Heavy sandstone occasionally displaces the roof shale and rests directly on the coal.

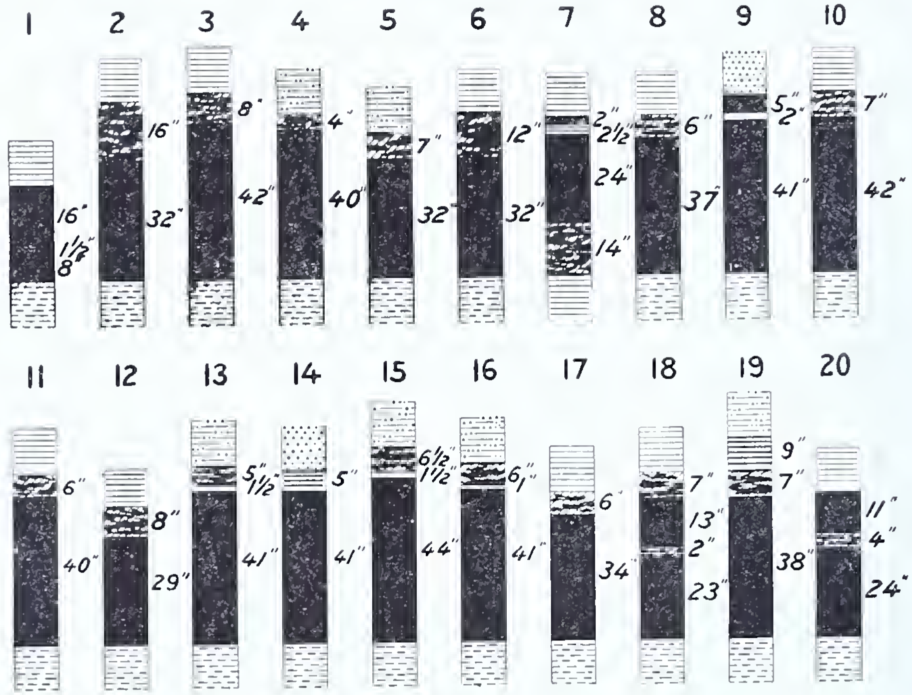

Figure 108. Sections of Lower Kittanning coal in Saltlick Township.

Letters and numbers designating location of sections refer to the 2½ minute quadrilaterals on the map, the capitals to tiers of quadrilaterals from west to east, the small letters to tiers of quadrilaterals from north to south, and the numbers to locations in each small quadrilateral. Unnamed sections are from small country banks or prospects.

1. Nb1. 2. Nb3. 3. Ob1, in diamond drill hole. 4. Mc1. 5. Nc1. 6. Nc7. 7. Oc1. 8. Oc13. 9. Oc2, in diamond drill hole. 10. Oc12, in diamond drill hole. 11. Oc6, Melcroft mine. 12. Oc8. 13. Oc11, in diamond drill hole. 14. Pc3, in diamond drill hole. 15. Pc6, in diamond drill hole. 16. Od2, in diamond drill hole. 17. Od3, Big Chief mine. 18. Od5, Sparks mine. 19. Od7, in diamond drill hole. 20. Pd4.

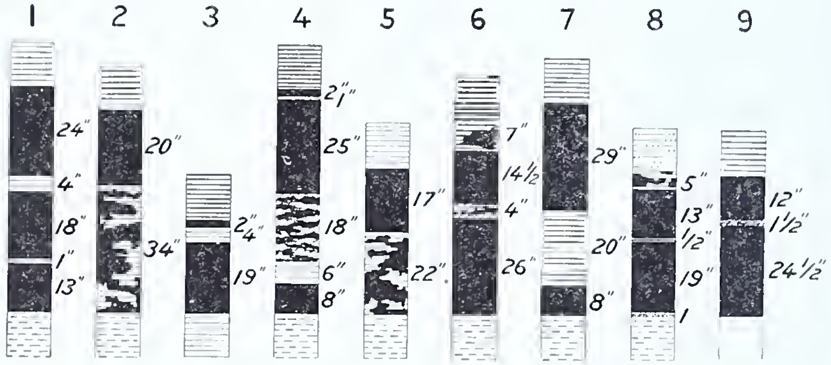

Figure 109. Sections of Upper Kittanning coal in Saltlick Township.

1. Ob1, in diamond drill hole. 2. Oc2, in diamond drill hole. 3. Oc7, in diamond drill hole. 4. Oc11, in diamond drill hole. 5. Pc3. 6. Pc5. 7. Pc6, in diamond drill hole. 8. Od6. 9. Pd3.

Middle Kittanning or C coal. The Middle Kittanning coal bed is usually lacking in Saltlick Township. It was observed in a few localities approximately 25 feet above the Lower Kittanning coal and to be less than 1 foot thick.

Upper Kittanning or C′ coal. This coal bed appears to be of mineable thickness in Ligonier Valley and on the slopes of Laurel Hill, but apparently it is cut out in the western part of the township. The bed lies 80 to 110 feet below the Upper Freeport coal. It has a dark gray to black shale roof and either a fire clay or black shale floor. The coal ranges from 2 to 5 feet thick and is either a double or triple benched bed divided by dark shale partings. The lower half of the bed is dirty, containing knife-edges of slate and lenses of pyrite, and is frequently a bony coal. The Upper Kittanning coal has been mined for custom coal in the vicinity of Indian Head.

Lower Freeport or D coal. The Lower Freeport coal bed is persistent in the township, but is not of mineable thickness except possibly in the vicinity of Indian Head and along Back Creek, where some abandoned openings on this coal indicate a fair thickness. Coal crops and blooms overlain by weak sandy shale or weak sandstone are found at this horizon in numerous localities, but none measure more than 15 inches. This coal bed lies 40 to 65 feet below the Upper Freeport coal.

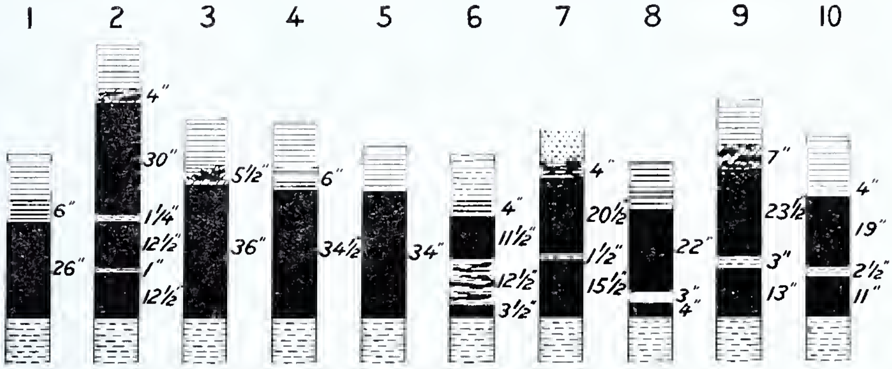

Figure 110. Sections of Upper Freeport coal in Saltlick Township.

1. Nc2. 2. Nc3. 3. Nc4. 4. Nc5. 5. Nd1. 6. Oc4. 7. Pc1. 8. Pc6, in diamond drill hole. 9. Pd2. 10. Od1.

Upper Freeport or E coal. The outcrop of the Upper Freeport coal coincides with the Allegheny-Conemaugh contact as shown on the map. This bed crops out in all the hills in the central part of the township. The structure carries the bed above ground 1¼ miles east and 4 miles west of the synclinal axis. In this township the Upper Freeport coal is generally of mineable thickness, but is reported to have a patchy occurrence, probably because the overlying Mahoning sandstone locally cuts or rolls down, entirely removing the normal roof shale and all or most of the coal bed. The thickness of the coal where it has not been disturbed by the Mahoning sandstone varies between 1 foot 3 inches and 5 feet and will average 3 feet. Its usual occurrence is in two benches separated by 2 to 3 inches of clay parting that occurs approximately 1 foot above the base of the bed. The bottom bench appears cleaner than the upper bench, which has knife blades of slate throughout, but especially near the top of the bed. ''Sulphur balls'' occur through the entire bed, but are more common in the basal 6 inches. The Upper Freeport coal has been opened in all parts of the township where it crops out.

CONEMAUGH COALS

Only two of the remaining Conemaugh coals, the Mahoning and Bakerstown, reach mineable thicknesses in parts of this township.

The Mahoning coal is mineable in the north-central part of the township and is a double- or triple-benched bed from 19 inches to 4 feet thick. Generally the top bench is bony and the whole bed is said to be high in sulphur and have a patchy occurrence. The Mahoning coal is 50 to 60 feet above the Upper Freeport coal.

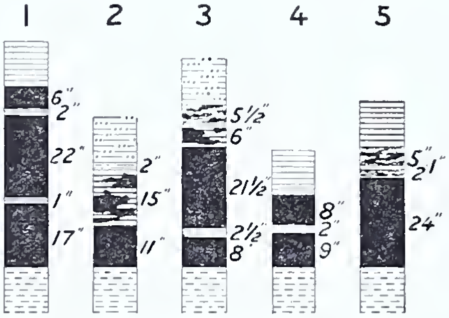

Figure 111. Sections of Mahoning coal in Saltlick Township.

1. Ob1, in diamond drill hole. 2. Nc8. 3. Oc3. 4. Oc11, in diamond drill hole. 5. Pc6, in diamond drill hole.

The Bakerstown coal was observed in a prospect bank (Nc6) 1 mile east of Davistown where about 17 inches of clean coal was exposed, with the base of the bed concealed. The coal was overlain by black to gray shale.

Clay and Shale

Several clay beds of the Allegheny formation in Saltlick Township may have future importance. The Lower Kittanning clay is exposed in the railroad cut (Od8) ¼ mile south of Indian Head. Here 6 feet of plastic and flint clay are exposed. The flint clay occurs as a 1-foot layer near the top of the bed and is apparently of intermittent nature, as it is not present in a 12-foot exposure of Lower Kittanning clay in the Sparks mine (Od5) of the Indian Creek Coal & Coke Company. The exposure in the railroad cut was sampled, and the physical tests for both the flint (sample 415) and plastic clay (sample 414) are given in Mr. Leighton's discussion.

The Bolivar flint clay was formerly stripped ¼ mile southeast of Roaring Run P. O., where a series of old pits (Pc2) show 4 to 6 feet of excellent flint clay. The clay bed occurs 10 to 15 feet below the Upper Freeport coal and evidently underlies the Upper Freeport limestone, numerous fragments of which are found. Sample 413, given in the county discussion of clay and shale, lists the results of physical tests on this clay.

The Upper Freeport clay was sampled 1 mile west of Jockey Knob School, where 7 feet of plastic clay, underlying the Upper Freeport coal, is exposed in a road cut (Nd1). The results of the physical tests (sample 412) are given in Mr. Leighton's clay chapter.

Limestone

The Loyalhanna limestone is exposed on Laurel Hill. Its thickness there probably is 40 to 50 feet. This limestone is acceptable for road metal, highway construction, and railroad ballast, but has no value as agricultural lime because of its high silica content. It was sampled from a road exposure (Pd5) just north of Longwood School and the results of the chemical analysis (F 100) are given in the general limestone discussion.

The Greenbrier limestone occurs in the Mauch Chunk formation 50 to 80 feet above the Loyalhanna limestone. Red and green shales (2 to 6 feet thick) generally overlie the Greenbrier, with medium- and heavy-bedded, green and drab micaceous sandstone overlying these shales. The limestone bed itself may be split in several beds by interbedded gray calcareous shale. This limestone is dark gray on fresh fracture, weathers light blue-gray, and contains copious marine fossils. Its principal use is as agricultural lime, and it has been quarried in many places for that purpose. As a rule, the overlying shale sloughs over the limestone so that exposures are rare. The quarry (Qd2) in the northeast township corner shows about 5 feet of limestone, with the base not exposed, and overlain by 4 feet of red and green shale capped by 6 feet of heavy-bedded drab sandstone. Near the junction of Trout and Neals Runs a quarry (Pd1) shows 3½ feet of limestone with the base concealed. Half a mile southwest from Longwood School, 2 feet of limestone is exposed in the quarry (Pd6), where the base of the bed is again concealed. It is thought from these exposures that the Greenbrier limestone is from 3 to 6 feet thick in Saltlick Township.

The fresh-water Johnstown limestone occurs near the middle of the Allegheny formation. In this township it lies 10 to 25 feet below the Upper Kittanning coal and varies between 0 and 10 feet thick. It is an impure, argillaceous limestone presenting a dark gray color on fresh fracture and mottled light gray and buff on weathered surfaces. An abandoned quarry (Oc5) just northeast of Melcroft has a reported thickness of 10 feet and was used for agricultural lime. The Johnstown limestone is reported in a number of diamond drill holes and outcrops (Nb2) near Kessler School and along the highway just northeast of Melcroft in a series of old quarries (Oc5). However, it is not persistent, as locally the Westernport sandstone cuts it out.

The Lower Freeport limestone is reported from a few diamond drill holes, but was not observed in outcrop. It is thin (up to 3 feet), nodular, and probably has very local occurrences.

The fresh-water Upper Freeport limestone of the Allegheny formation has been opened near Roaring Run (Pc2) in conjunction with the Bolivar flint clay and along Back Creek (Od1), where it is 18 feet below the Upper Freeport coal. A road section (Nd1) exposes 4 inches of nodular limestone 15 feet below the Upper Freeport coal. The limestone ranges from 0 to 3 feet thick, has a nodular occurrence and presents a brecciated appearance, caused by stringers and pockets of clay.

SPRINGFIELD, STEWART, AND HENRY CLAY TOWNSHIPS

Springfield, Stewart, and Henry Clay townships are discussed as a unit because of the similarities of the outcropping strata, underlying rock structure, and topography. They lie along the eastern boundary of Fayette County. Henry Clay Township is in the southeast corner and Stewart and Springfield townships in the eastern-central area. The two latter townships lie in the Ligonier valley and extend from the crest of Laurel Hill to the crest of Chestnut Ridge. Henry Clay Township extends from the Youghiogheny River westward across Laurel Hill to its western foothills.

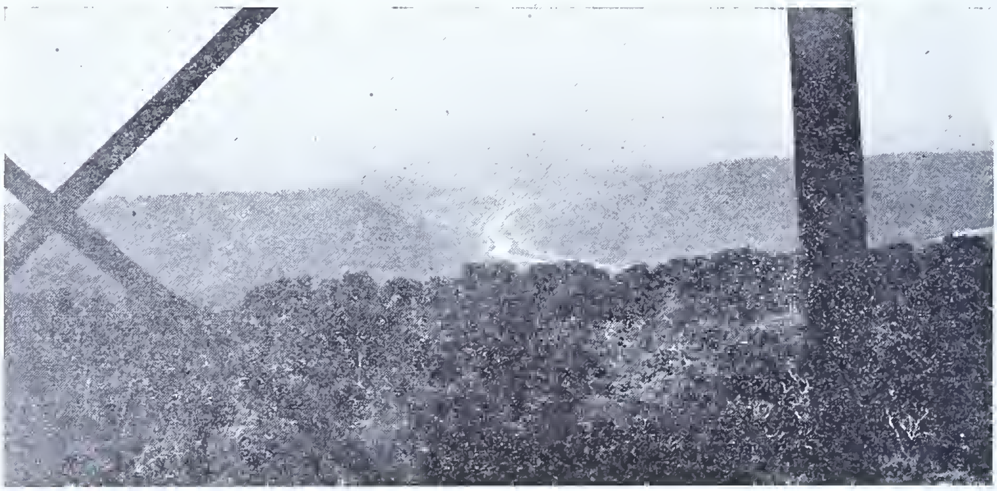

Figure 112. Youghiogheny River northwest from Sugarloaf fire tower.
Gap in ridge of Homewood sandstone.

The area under discussion is drained chiefly by the Youghiogheny River, which follows an entrenched winding course along the east boundary of Henry Clay Township, through Stewart Township, and along the west part of the southern boundary of Springfield Township. It passes through Laurel Hill and Chestnut Ridge in deep gorges, roughly in an east-west direction. In the Turkeyfoot Valley (Somerfield-Confluence), the river has a northerly direction in a meandering entrenched valley with steep sides. It also has a northerly course in the Ligonier Valley, where it flows through a winding, narrow, cliff-sided gorge. Important tributaries to the Youghiogheny River in the area are Buffalo, Hall, Tub, and Ramcat Runs in Henry Clay Township; Beaver, Cucumber, Jonathan and Bear Runs in Stewart Township; and Indian Creek in Springfield Township.

The topography of the area is rugged and the minor streams are entrenched in deep, steep-sided valleys in all except their headwaters. In the Turkeyfoot Valley the hills have small, rather flat tops that are between 1,800 and 1,900 feet above tide. Laurel Hill, north of the National Pike, has knobs along its crest from 2,700 to 3,000 feet above sea level. The mountain appears to have a double crest, for west of the main crest is a series of detached knobs that are 200 to 300 feet lower than the continuous eastern crest. The west slopes of Laurel Hill are deeply notched by numerous streams to form hollows and spurs. South of the pike the ridge rapidly loses altitude, and loses its identity before the State boundary line is reached. In Ligonier Valley the hills have either small, flat or round tops that have general altitudes of 1,600 to 1,900 feet north of Ohiopyle. South of Ohiopyle the topography loses some of its ruggedness, but the altitude of the hilltops rises to about 2,000 feet. From Ligonier Valley the slopes rise relatively slowly to the crest of Chestnut Ridge. The top of the ridge reaches altitudes of 2,300 to 2,400 feet north of the Youghiogheny River.

Railroads serving the area are the Baltimore & Ohio and the Western Maryland, both of which have main trunk lines along the Youghiogheny River below Confluence. Branch lines of the Baltimore & Ohio Ohio extend along Indian Creek and along the Youghiogheny River above Confluence. Other transportation depends on the several paved highways that traverse the area from east to west and north to south. A net work of secondary roads is maintained. Industries of the area are farming, lumbering, railroading and coal mining. The coal is mined chiefly for local use.

Structure

Springfield and Stewart townships lie across the Ligonier syncline, extending roughly from the axis of Laurel Hill anticline to the axis of the Chestnut Ridge anticline. The syncline has a relatively flat bottom from 2 to 3 miles wide through these townships. The west limb rises fairly rapidly to the axis of Chestnut Ridge anticline with a maximum rate of approximately 500 feet per mile. The east limb of the syncline rises steeply with a maximum rate of 1,100 feet per mile to the relatively wide and flat crest of Laurel Hill anticline. The axis of Laurel Hill anticline is from ½ to 1 mile east of and roughly parallel to the eastern boundary line. This axis passes through a series of "saddles" and "highs," but maintains its structural elevation southward to Sugarloaf fire tower (Ni). Here it loses about 600 feet in structural elevation to a low at Beaver Creek and then gains about 175 feet to a small, round "high" at the National Pike. South from this "high" it loses 450 feet structurally to the State boundary, where the crest of the anticline is narrow and sharp. In Henry Clay Township the west flank of the Laurel Hill anticline has a relatively gentle downward slope. However, the east limb plunges rapidly to

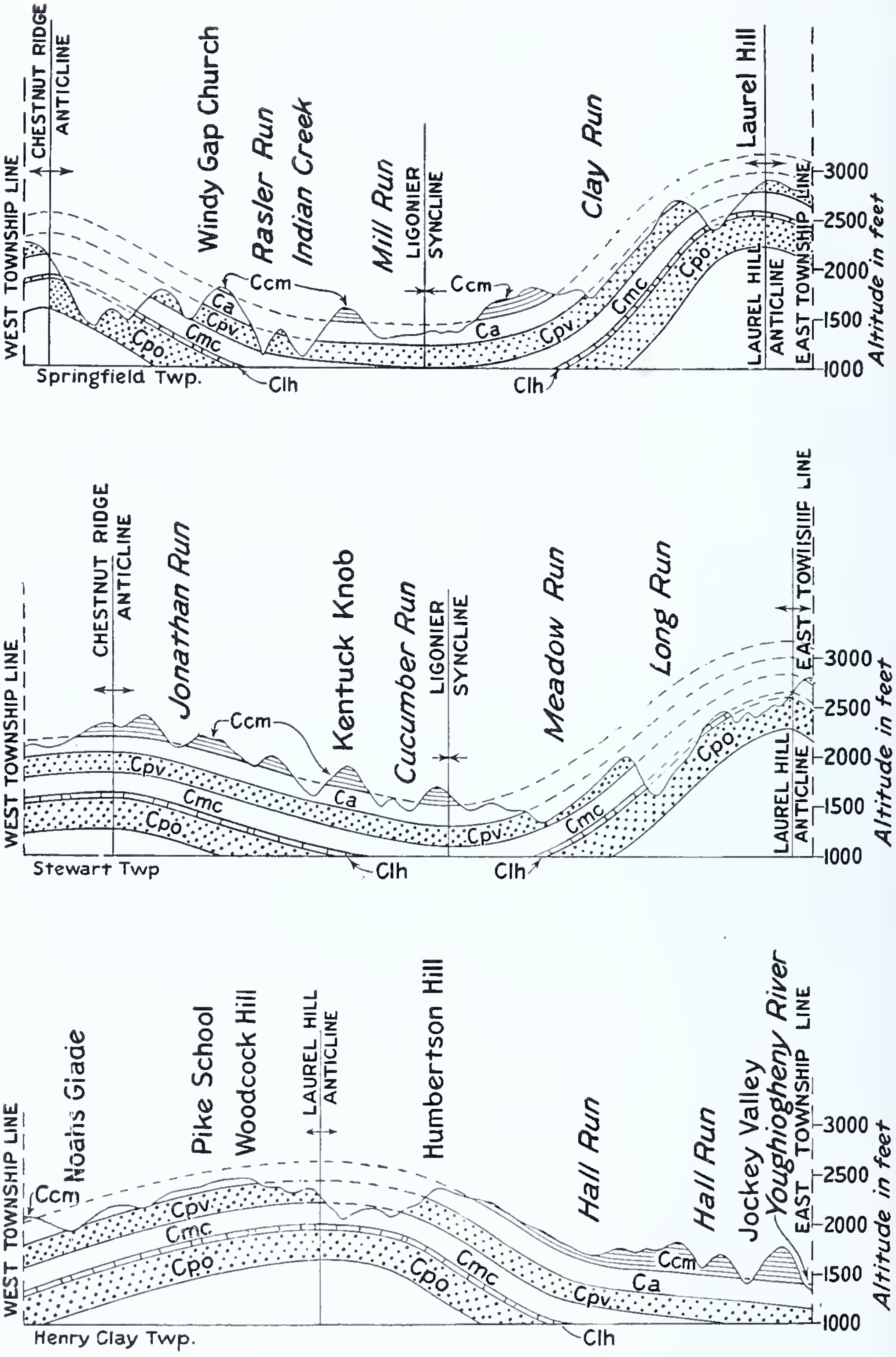

Figure 113. Structure sections across Springfield, Stewart, and Henry Clay Townships.

Legend: Ccm—Conemaugh formation; Ca—Allegheny formation; Cpo—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series.

the wide and flat bottom of the Johnstown syncline. The axis of the Johnstown syncline passes through Confluence, Horseshoe Bend and Watsondale.

A thrust fault dipping northwest crosses Youghiogheny River near Victoria in Stewart Township, according to Wilson M. Laird. The fault occurs only in the Devonian red beds and extends along Rock Spring Run to Bear Run.

Stratigraphy

The consolidated strata that crop out in these townships range in age from Chemung of late Devonian time to Upper Conemaugh of Pennsylvanian time and make up a total stratigraphic section of about 2,450 feet. The younger rocks are exposed in the Ligonier and Turkeyfoot valleys and the older ones crop out near the crests of Laurel Hill and Chestnut Ridge and in the gorges of the Youghiogheny River through these mountains. Unconsolidated deposits of sand and gravel of Recent age occur along the Youghiogheny River and are rather extensive in the present flood plain in Turkeyfoot Valley.

DEVONIAN

Chemung and post-Chemung strata. Devonian strata are exposed in the gorges cut by the Youghiogheny River in its course through Laurel Hill and Chestnut Ridge and in several of the deep hollows cut into the western slopes of Laurel Hill. The greatest thickness above drainage is about 900 feet in the gorge through Laurel Hill. On the basis of faunal evidence obtained chiefly from the exposures on Chestnut Ridge, the upper limit of the group is placed directly under a subnormal thickness for the Pocono series. Using this boundary, the upper 200 to 250 feet of the Chemung and post-Chemung group in the Chestnut Ridge gorge consists of gray shale, sandy shale and sandstone. This portion is underlain by approximately 200 feet of dominantly red clayey and sandy sediments. Underlying strata are poorly exposed, but appear to be gray and drab shales and sandstones. In the gorge through Laurel Hill, Hickok, in the general stratigraphy discussion, states that about 280 feet of red beds lie directly under the Pocono series. Below these red beds a concealed interval of about 200 feet is followed by an exposure of 185 feet of drab to gray sandstone with minor amounts of shale. At Bidwell near the center of this gorge, the author observed the following generalized section along the secondary road leading up Camp Run to the crest of the mountain:

Section of Devonion strata near Bidwell

Feet	
10	Loyalhanna limestone
25	Concealed
15	Gray sandstone
20	Concealed
5	Drab shale
130	Gray sandstone
25	Concealed
10	Gray sandstone, conglomeratic
20	Concealed
10	Gray sandstone, conglomeratic
235	Concealed
10	Buff shale
20	Buff sandstone
60	Concealed
130	Red shale with red sandstone
20	Concealed
20	Red and green shale
30	Concealed
30	Red shale and sandstone
20	Green and gray sandstone
35	Red shale
5	Green sandstone, flaggy
70	Concealed
10	Green and gray sandstone
20	Concealed to river level

According to this section, the interval from the base of the Loyalhanna formation to the top of the red beds as exposed is nearly 600 feet, and is composed of gray and drab sandstone and shale as observed from outcrops and talus. This compares with an approximate similar interval of 550 feet in the gorge through Chestnut Ridge. Using only the lithologic characteristics of this section and disregarding the faunal determination of the base of the Pocono series, this group of strata can definitely be considered as one unit bounded at the top by the Loyalhanna formation and at the base by the red beds. From a practical viewpoint, this lithologic unit is highly desirable, as it represents the "Pocono series" of the oil and gas industry in western Pennsylvania. Both the lithologic Pocono series and the red beds (Catskill facies) thicken rapidly to the east. When the eastward thickening is considered, there is a remarkable similarity of lithology and sequence between the sections of Fayette County on Chestnut Ridge and Laurel Hill and those reported by Reger[1] for the Broad Top basin at Riddlesburg in Bedford County. This similarity is shown by the following generalized measurements.

Fayette County Chestnut Ridge	Fayette County Laurel Hill	Bedford County Riddlesburg
Red shale	Red shale	Red shale
Loyalhanna	Loyalhanna	—
300 feet gray sandstone	350 feet gray sandstone	500 feet gray sandstone
? " fossiliferous shale and sandstone	?	95 " fossiliferous siliceous shale
250 feet gray shale and sandstone	250 feet gray shale and sandstone	550 feet gray sandstone
Red beds (Catskill)	Red beds (Catskill)	Red beds (Catskill)

MISSISSIPPIAN

Pocono series. Strata of the Pocono series are exposed in the gorges of Youghiogheny River in Chestnut Ridge and Laurel Hill and along the crest and upper spurs and hollows of Laurel Hill. The southernmost exposure is in the deep hollow just south of Sugarloaf Mountain. Exposures of these strata in the area are poor and short. It is indicated, however, that the series has an average thickness of about 350 feet when the faunal lower limit as determined on Chestnut Ridge is used. The strata are dominantly sandy and consist of medium- to massive-bedded, coarse-grained, gray to buff sandstone. Some conglomeratic sections with pebbles up to ¾ inch were observed. The series contains some thin beds or lenses of gray shale interbedded with sandstone.

Loyalhanna formation. The Loyalhanna formation has thicknesses of 30 to 55 feet in the area under discussion and the average thickness decreases slightly northward. This formation crops out in the Chestnut Ridge and Laurel Hill gorges of the Youghiogheny River. Along the crest and middle slopes of Laurel Hill it is exposed in a continuous line of outcrops from northeast Springfield Township southward to the valley of Beaver Creek in Henry Clay Township, where it plunges below the surface. In this area the formation is composed of the usual dense, gray, siliceous limestone that exhibits its highly cross-bedded character on weathered outcrops. On Laurel Hill the strata have a slightly reddish color at some localities.

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[1] Reger, D. B., Pocono stratigraphy in the Broad Top Basin of Pennsylvania: Geol. Soc. America Bull., vol. 38, pp. 397-410, 1927.

Mauch Chunk formation. The Mauch Chunk formation crops out in the two gorges of Youghiogheny River through the mountains and is continuously exposed near the crest and well down the west slope of Laurel Hill from the northeast corner of Springfield Township southward to Sugar Loaf Mountain. The southernmost exposure is in the valley of Beaver Creek in Henry Clay Township. The total thickness of the formation through the area is from 225 to 250 feet and is divided into three parts by the persistent Greenbrier limestone. The lower part is composed of red and green shale and sandstone and ranges in thickness from about 40 feet at Beaver Creek School in Henry Clay Township to a maximum of about 70 feet in northeast Springfield Township. It is overlain by the Greenbrier limestone, which decreases northward in thickness from a maximum of 25 feet at Beaver Creek School to about 10 feet at the northeast corner of the area. The Greenbrier member is composed chiefly of massive and thick-bedded, gray-blue, fossiliferous limestone with minor amounts of gray, interbedded lime shale. The upper member of the formation has an average thickness of 150 feet and is composed mainly of red and green shales with some thin-bedded red and drab sandstones. North of the Youghiogheny River, the lower part of this member is composed of a heavy-bedded, drab sandstone from 20 to 40 feet thick that lies a short interval above the Greenbrier limestone.

PENNSYLVANIAN

Pottsville formation. Strata of the Pottsville formation cap the crest of Laurel Hill between the National Pike and the northeast corner of the area and are exposed along the middle and lower slopes of Laurel Hill. They also have a continuous outcrop along the Youghiogheny River from Ramcat Run in Henry Clay Township to the southwest corner of Springfield Township. The formation is above drainage in the stream valleys of Stewart Township. A short distance south of the National Pike it plunges below the surface. Strata of the formation have an average thickness of about 200 feet and are divisible into three members in these townships. The lower or Connoquenessing member consists chiefly of buff to light gray, coarse-grained, heavy-bedded sandstone that contains frequent occurrences of conglomerate. It is 90 to 120 feet thick. The Mercer or middle group is from 15 to 35 feet thick and consists of dark to drab shale with several thin coal and clay beds. Thin lenses of sandstone are commonly present. The upper or Homewood member contains from 30 to 55 feet of heavy- to massive-bedded, coarse-grained, gray sandstone that is overlain by 10 to 20 feet of medium-bedded, slabby, drab sandstone. Layers of conglomerate are commonly present in the lower part.

Allegheny formation. Exposures of the rocks of the Allegheny formation are found in the stream valleys of the Ligonier Valley, from which they extend into the lower slopes of Laurel Hill and up to the crest of Chestnut Ridge in Springfield and Stewart townships. In Henry Clay Township these rocks have an unbroken outcrop across the crest of Laurel Hill south of the National Pike. On the east slopes of Laurel Hill the strata of this formation plunge rapidly towards the Turkeyfoot Valley, where only the upper members are exposed in isolated windows along the Youghiogheny River and at Jockey Valley. At the base of the formation the Brookville-Clarion coal horizon has a persistent occurrence. It is overlain in Henry Clay Township by a good development of the Clarion sandstone, which is heavy- to massive-bedded and coarse grained. To the north in Stewart and Springfield townships the greater part of the Clarion sandstone is usually replaced by a drab to dark shale. The Lower Kittanning clay and coal are persistent and are generally overlain by 5 to 20 feet of dark to drab shale. The overlying Westernport member is present as a massive, coarse-grained sandstone with conglomeratic layers in Springfield Township. Southward in Stewart and Henry Clay townships it becomes a thin- to medium-bedded sandstone. The portion of the formation above the Westernport sandstone is composed chiefly of drab to dark shales with local, thin sandstone beds. The Upper Kittanning and Lower Freeport coal beds have persistent occurrences in this interval. Locally the Butler sandstone between the Lower and Upper Freeport coal beds becomes medium to heavy bedded. The Upper Freeport limestone, clay, and coal have persistent occurrences through the area.

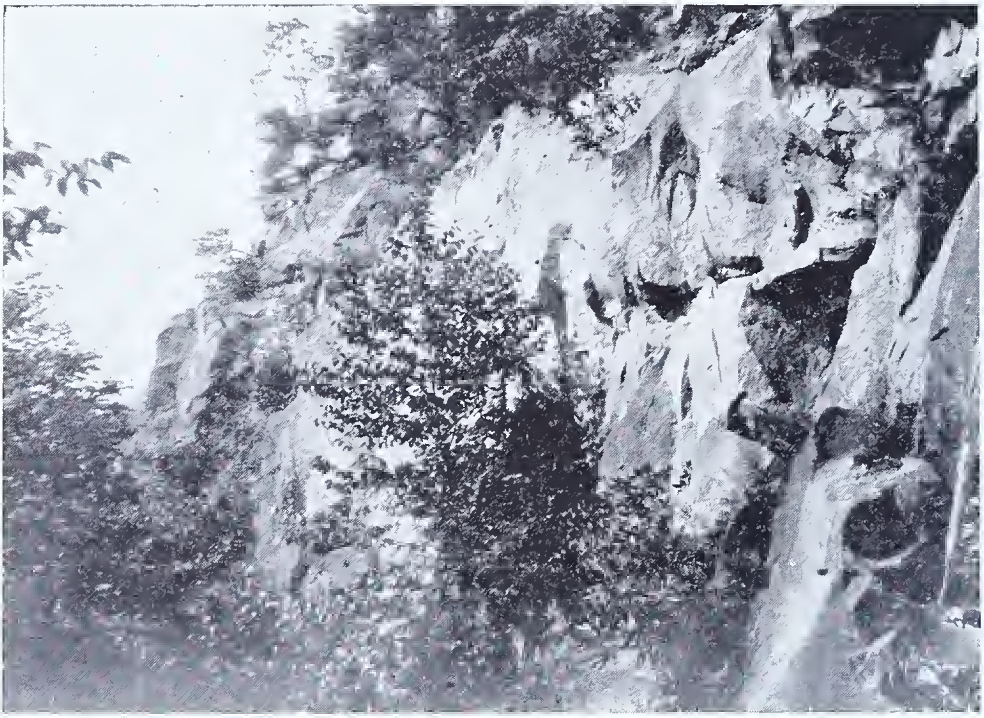

Figure 114. Pottsville sandstone in quarry at mouth of Bear Run.

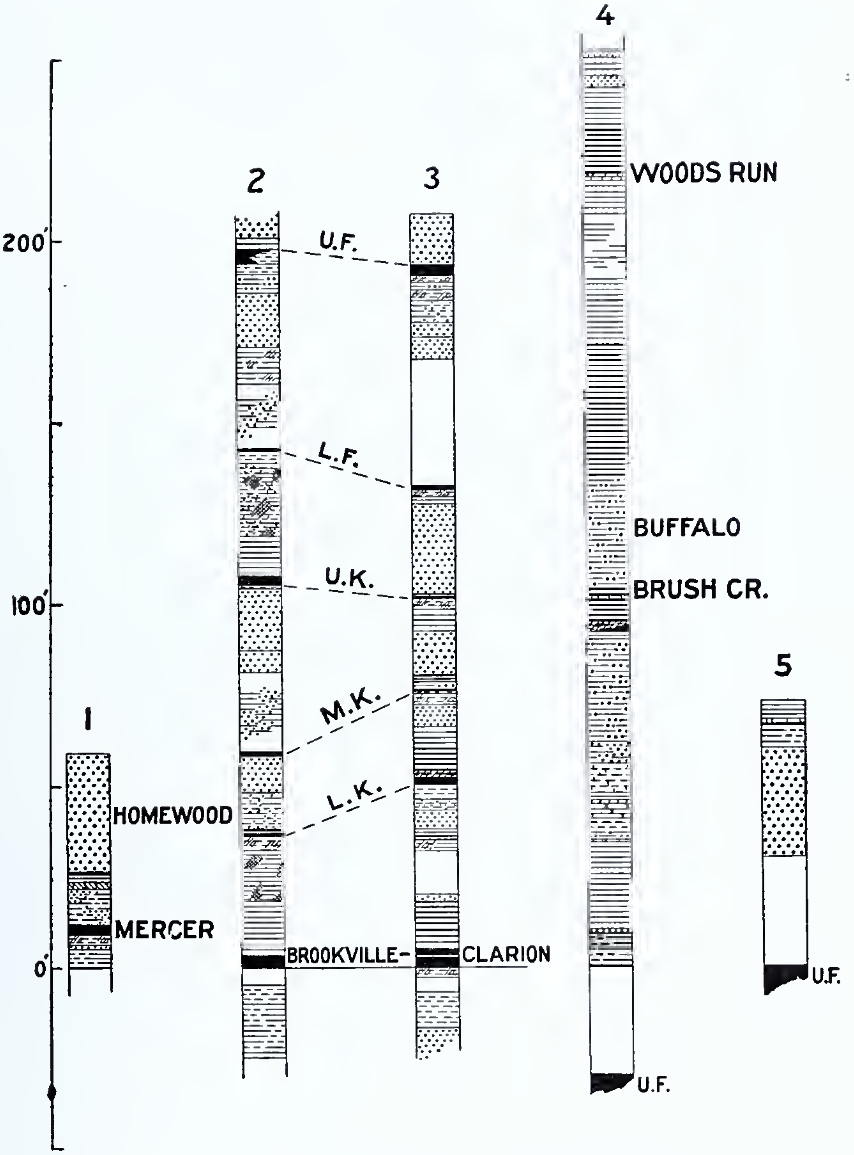

Figure 115. Stratigraphic sections in Springfield, Stewart, and Henry Clay Townships.

1. Section of Mercer group, Pottsville formation, exposed in Cucumber Falls (Lh5).
2. Section of Allegheny formation along road northwest from Cucumber Falls (Lh).
3. Section of Allegheny formation along State highway north of Jim Run (Mg).
4. Section of lower Conemaugh formation along National Pike west from Stuck Hollow (Nk, Nj).
5. Section of lower Conemaugh formation on west bank of Youghiogheny River, ½ mile north of Somerfield (Oi).

The Allegheny formation ranges in thickness from 200 to 225 feet in the Ligonier Valley and has a slightly greater thickness in the Turkeyfoot Valley. Near the crest of Chestnut Ridge in Springfield and Stewart townships, field observations indicate that the formation has a similar subnormal thickness to that described in the discussion on Connellsville and Dunbar townships.

Conemaugh formation. Strata of the lower two-thirds of the Conemaugh formation are present in Springfield, Stewart and Henry Clay townships, where they crop out in the hills through Ligonier and Turkeyfoot valleys. In the Ligonier Valley these strata extend nearly to the crest of Chestnut Ridge and in the Turkeyfoot Valley near the State boundary they extend in unbroken outcrop across the crest of Laurel Hill. Strata of this age are the youngest consolidated rocks in the area and approximately 550 feet remain uneroded in the highest hills of the major valleys. This formation thickens eastward so that intervals of prominent persistent beds to the base of the formation are slightly greater in Turkeyfoot Valley than in Ligonier Valley. The increase in thickness appears to take place above the horizon of the Brush Creek coal and limestone. At the base of the formation the Mahoning is well developed and consists of the Lower and Upper Mahoning sandstones, which are separated by the Mahoning coal, clay, limestone, and shale. The Lower Mahoning sandstone is generally present as a heavy-bedded, coarse-grained, gray sandstone, but locally it may be entirely replaced by shale or sandy shale. The Upper Mahoning sandstone consists generally of thin- to medium-bedded sandstone, sandy shale and shale. In the vicinity of Somerfield, exposures of the relatively rare, red shale bed in the Middle Mahoning member were observed. This red shale was exposed in only one other section of Fayette County, in the vicinity of Gibbon Glade, Wharton Township. Above the Mahoning group the Brush Creek coal, limestone, and black shale are persistent through the three townships. They are overlain by clay shales and clays that have a red color at the top. This red shale phase represents the Meyersdale red beds, which are directly overlain by the Buffalo sandstone. The Buffalo member is present locally as a prominent sandstone, but generally it is sandy shale or thin-bedded sandstone. Red, green, and yellow shales that contain the Lower Bakerstown and Bakerstown coal beds lie between the Buffalo and Saltsburg sandstones and exhibit the same characteristics wherever seen. The Saltsburg member has a persistent occurrence in all townships as a medium to heavy gray to buff sandstone, although very locally it may show a shaly phase. It is overlain by a shale and clay shale series to the Morgantown sandstone. This shale interval contains drab, red, green, and yellow shales and several thin coal and limestone beds that may have local thicknesses sufficient for custom use. The Morgantown member is generally a thin- to heavy-bedded, drab sandstone that caps the highest hills in the Turkeyfoot Valley. In the extreme southeast corner of Henry Clay Township a good development of the Clarksburg limestone is found at the top of the hills. The remainder of the Conemaugh formation has been removed by erosion.

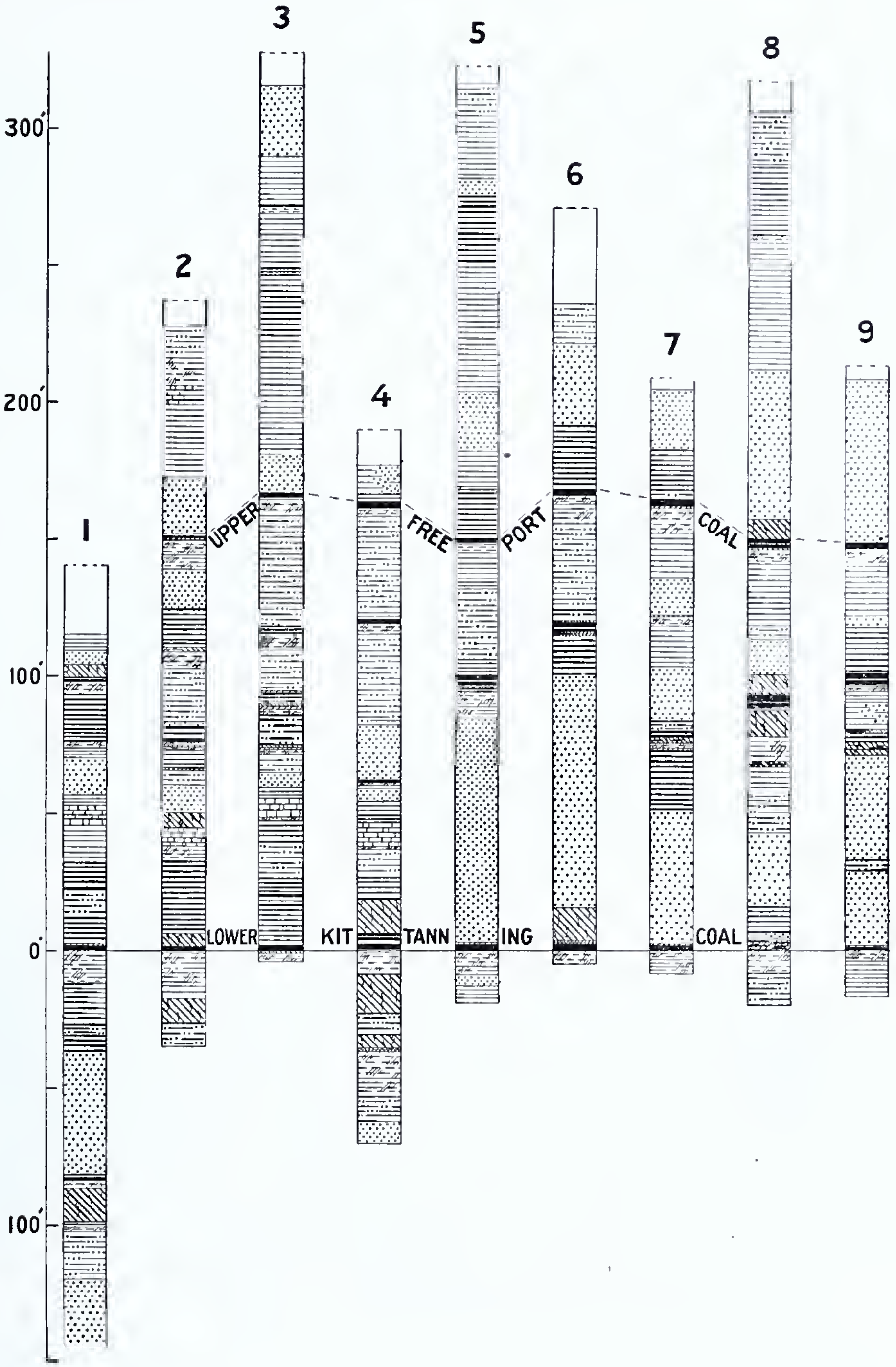

Figure 116. Stratigraphic sections near Normalville and Poplar Run School.

DIAMOND DRILL HOLES

1. Ne8, ¾ mile southeast of Normalville.
2. Ne7, ¾ mile southeast of Normalville.
3. Ne6, ⅜ mile southeast of Normalville.
4. Ne5, ½ mile east of Normalville.
5. Ne3, 1 mile east of Normalville.
6. Nd5, 1¼ miles east of Normalville.
7. Nd6, ¾ mile southeast of Poplar Run School.
8. Nd7, ⅜ mile southeast of Poplar Run School.
9. Nd8, ¼ mile south of Poplar Run School.

Diamond-drill-hole records furnished by the Indian Valley Mine Drainage Company.

Coal Resources

The commercial coal resources of Springfield, Stewart and Henry Clay townships appear to be limited to the coal beds of the Allegheny formation. The coals of the Conemaugh and Pottsville formations attain mineable thickness locally, but at present or in the near future cannot be considered to have commercial value. They are suitable, however, for development to furnish coal for local use. The following table gives intervals between the more persistent coal beds in the area:

Intervals between various coal beds and the Upper Freeport coal, in feet

Coal	Average	Range
Harlem	?	400
Bakerstown	250	240 to 265
Lower Bakerstown	180	170 to 185
Brush Creek	120	105 to 140
Mahoning	60	40 to 75
Upper Freeport (top)	0	0
Lower Freeport	55	35 to 65
Upper Kittanning	100	90 to 115
Lower Kittanning	155	140 to 175
Brookville-Clarion	215	200 to 250
Mercer	295	280 to 310

The intervals of the coal beds of Allegheny age apply only where the formation has its normal thickness of 200 to 250 feet and do not apply to the subnormal thickness that is believed to occur on the upper slopes of Chestnut Ridge and Laurel Hill.

POTTSVILLE COAL

The Mercer bed is the only coal in this formation that attains mineable thickness at any place in the area. It occurs near the middle of the formation, lying 70 to 95 feet below the top. It crops out at numerous localities on the slopes of Chestnut Ridge and Laurel Hill and in the gorge of Youghiogheny River in its course through the Ligonier Valley. It reaches local thicknesses of 55 inches and generally contains a persistent clay parting near the base and several nonpersistent thin shale or clay binders. The thickness varies greatly in short distances and is generally less than 20 inches. Thin lenses and nodules of pyrite are commonly present and the coal has a rather dirty appearance.

ALLEGHENY COALS

Coal beds of the Allegheny formation that are or have been worked commercially are the Upper Freeport, Lower Freeport, Upper Kittanning, Lower Kittanning and Brookville-Clarion beds. They crop out in the Ligonier Valley and on the slopes of Chestnut Ridge and Laurel Hill. In the Turkeyfoot Valley only the Upper Freeport bed is above drainage.

Brookville-Clarion or A coal. The Brookville-Clarion coal at the base of the formation has a persistent occurrence and is generally mineable throughout the three townships. It ranges in thickness from 12 inches to 13 feet and is generally thicker in the southern part of the area than in the northern part. The character of the bed varies greatly, from a clean coal section without binders to a section in which partings or binders comprise about 1/3 of the total thickness. There are two fairly persistent partings, a lower one of clay about ½ to 4 inches thick occurring 12 to 24 inches above the base, and an upper one also of clay from 3 to 8 inches thick near the top of the bed.

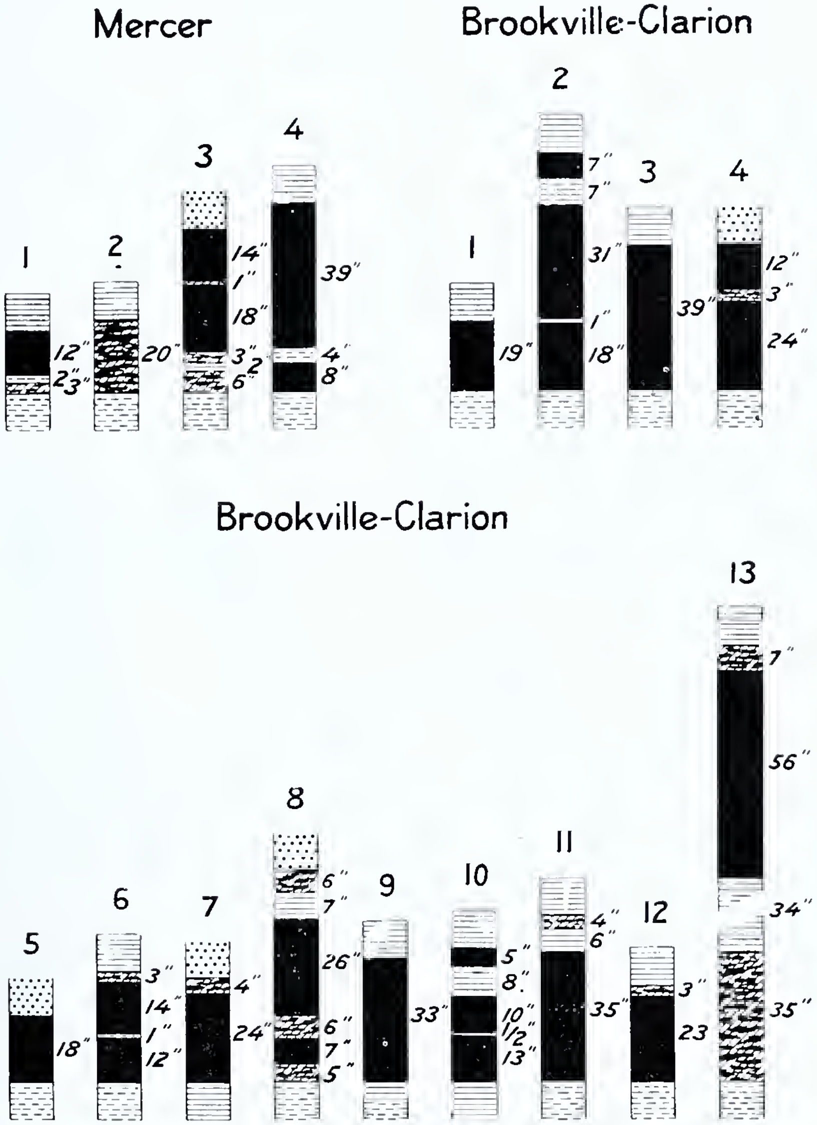

Figure 117. Sections of Mercer and Brookville coals.

Mercer coal: 1. Ld4. 2. Mg3. 3. Lh5. 4. Mj3.

Brookville-Clarion coal: 1. Ld5. 2. Md3. 3. Md4. 4. Od11. 5. Oe6. 6. Me1. 7. Mg6. 8. Mg8. 9. Mg10. 10. Mh1. 11. Mh2. 12. Mh6. 13. Mj4.

Layers of bone coal up to 9 inches thick occur at the top and bottom of the bed. Balls and streaks of pyrite are commonly found near the bottom of the bed. In the only section (Mj4) obtained in the area south of the National Pike, an unusual thickness of 13 feet was shown.

Here the bed has an upper bench of about 6 feet and a lower bench of about 3 feet separated from the upper bench by approximately 3 feet of dark shale. This great thickness is believed to have only local extent as blooms of the beds observed nearby did not indicate an unusual thickness. The floor of the bed is gray clay and the normal roof is drab to dark shale, which may be replaced over large areas by the overlying Clarion sandstone. Locally this sandstone cuts or rolls down and replaces the upper part of the bed. This coal lies at an average interval of 215 feet below the top of the Upper Freeport coal.

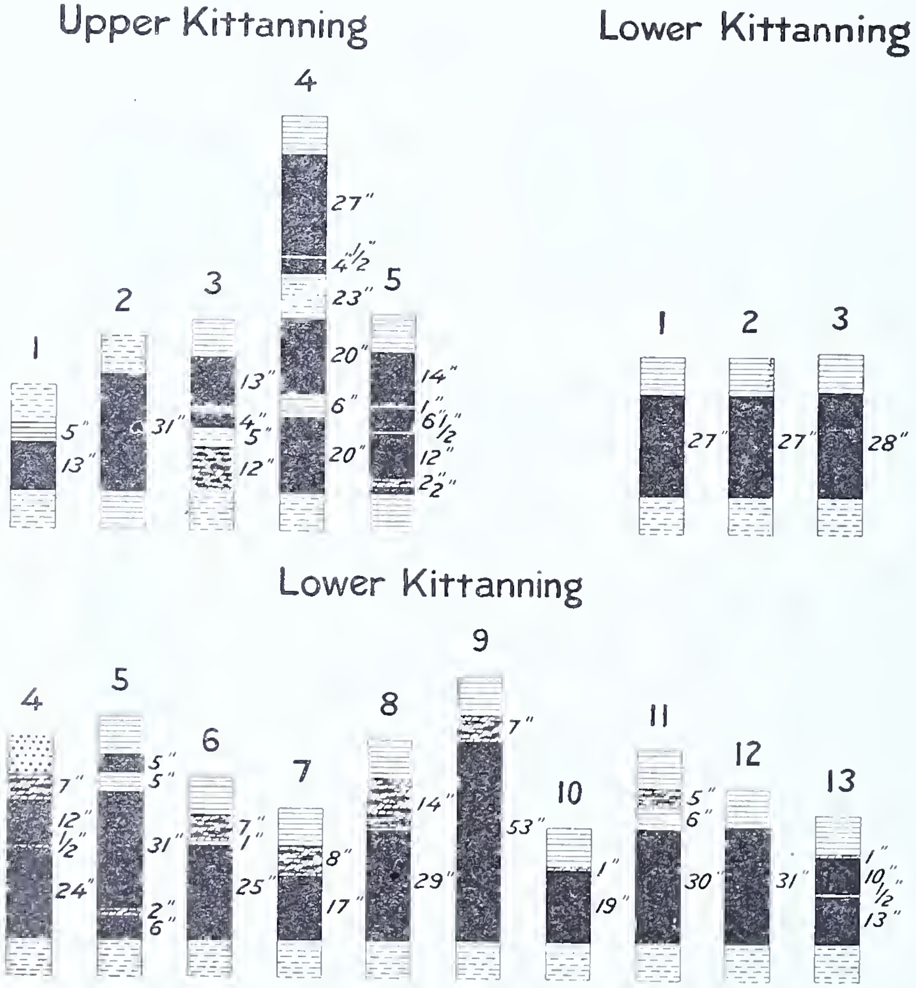

Figure 118. Sections of Kittanning coals.

Upper Kittanning coal: 1. Md8. 2. Nf8. 3. Lh2. 4. Mh9. 5. Oi1, Kephart mine.
Lower Kittanning coal: 1. Md5. 2. Md6. 3. Md7. 4. Od9. 5. Me4, Cox mine. 6. Mf5. 7. Mg5. 8. Mg9. 9. Lg2. 10. Lh3. 11. Mh3. 12. Mh7. 13. Oi2.

Lower Kittanning or B coal. The Lower Kittanning coal is the most important and is the most persistently mineable bed in the three townships. It is overlain generally by 3 to 20 feet of dark to gray shale that has a characteristic banded appearance and forms a good mine roof. Locally sandstone may occur immediately on top of the coal. The bed is underlain by gray plastic clay. The Lower Kittanning coal is from 18 to 60 inches thick throughout the area and consists of clean coal in all except the top 1 to 14 inches, which is usually a bone coal or consists of alternating thin layers of coal and black shale. One or two bone binders of very local character and from ½ to 2 inches thick may occur near the middle of the bed. This coal lies 140 to 175 feet below the top of the formation.

Upper Kittanning or C′ coal. The Upper Kittanning coal occurs at an average interval of 100 feet below the top of the Upper Freeport coal and is persistent through the area. It varies from 10 to 108 inches thick, with an average thickness of about 30 inches. It generally contains two or more partings of shale or clay, of which each one may attain a thickness of 3 to 5 inches. The lower part of the bed frequently consists of bony coal and the remainder of the bed may locally show numerous lenses and balls of pyrite. Near Oak Grove School the coal has an exceptional thickness of nearly 9 feet, which is apparently only of local extent. Drab to gray shale immediately overlies the bed. Just east of Mill Run a bed of cannel coal that is correlated with the Upper Kittanning horizon has been opened (Nf2).

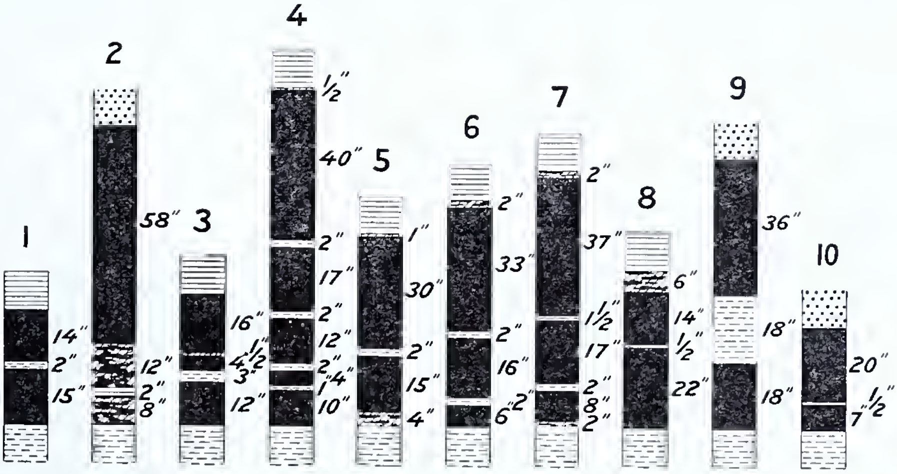

Figure 119. Sections of Lower Freeport coal.

1. Nd3. 2. Nd4. 3. Oe4. 4. Ne1. 5. Ne4. 6. Ne12, Indian Creek No. 2 mine. 7. Ne14, Wynn Grove mine. 8. Me2 9. Nf9. 10. Mh4, Bailey mine.

Lower Freeport or D coal. The Lower Freeport coal lying about 55 feet below the Upper Freeport bed, has a persistent occurrence. It is from 6 to 96 inches thick with an average of about 30 inches. From two to five thin shale or clay partings are generally present in the lower half of the bed. The upper half contains fairly clean coal. Lenses and balls of pyrite have a scattered occurrence through the bed. The Lower Freeport coal is best developed in the vicinity of Whites Bridge and Normalville, where it is from 50 to 96 inches thick. It has been mined extensively in this part of Springfield Township. Elsewhere in the area under discussion, the bed is usually less than 36 inches thick. The normal roof of the coal is gray shale, which is frequently replaced by the overlying Butler sandstone, notably in Springfield Township.

Upper Freeport or E coal. The Upper Freeport coal at the top of the Allegheny formation is persistently mineable through the three townships. It is from 24 to 75 inches thick. The coal generally is thicker in the southern part of the area than in Springfield Township, where the bed is known locally as the "block-slate" coal. This name is derived from the blocky character of a shale or bone parting that occurs near the middle of the bed at Mill Run. In Springfield Township the bed is double-benched and in Stewart and Henry Clay townships it is generally in three benches. In addition to the one or two major partings of clay generally present in the bed section, there are several thin, non-persistent partings or binders of clay or shale. A

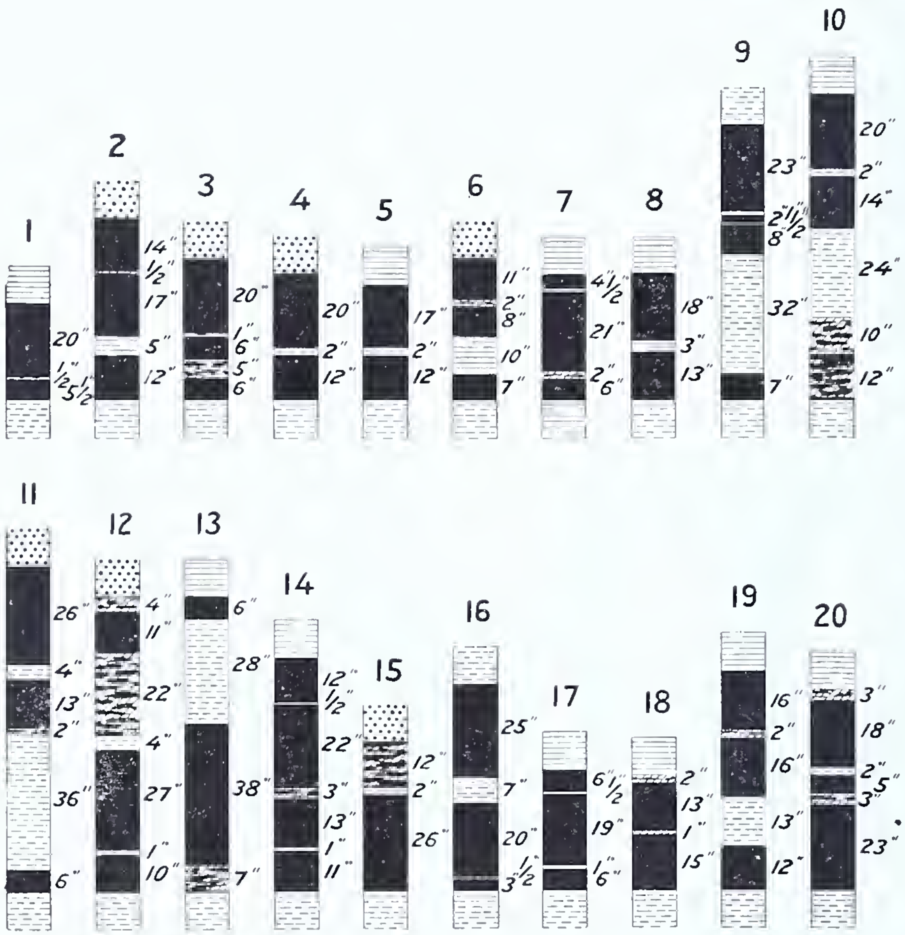

Figure 120. Sections of Upper Freeport coal.

1. Md10. 2. Nd2. 3. Od10. 4. Ne15. 5. Me6, Penny mine. 6. Mf3. 7. Mf4. 8. Nf4. 9. Nf6. 10. Nf7. 11. Mg7, Scarlett mine. 12. Kh2. 13. Lh1. 14. Mh8. 15. Nj2. 16. Nj3. 17. Oj3. 18. Ok1. 19. Nk2. 20. Mk2.

layer of bone coal is commonly present at the base of the bed. The middle section of the bed contains the cleanest coal and does not show the pyrite lenses that are found near the top and bottom. In some areas, as near Ohiopyle and Somerfield, the entire bed section shows clean coal with a minimum of partings. The roof of the coal is either a gray shale or a sandstone that replaces the shale over large areas. The sandstone locally rolls down and replaces some or all of the coal bed. A gray plastic clay forms the floor.

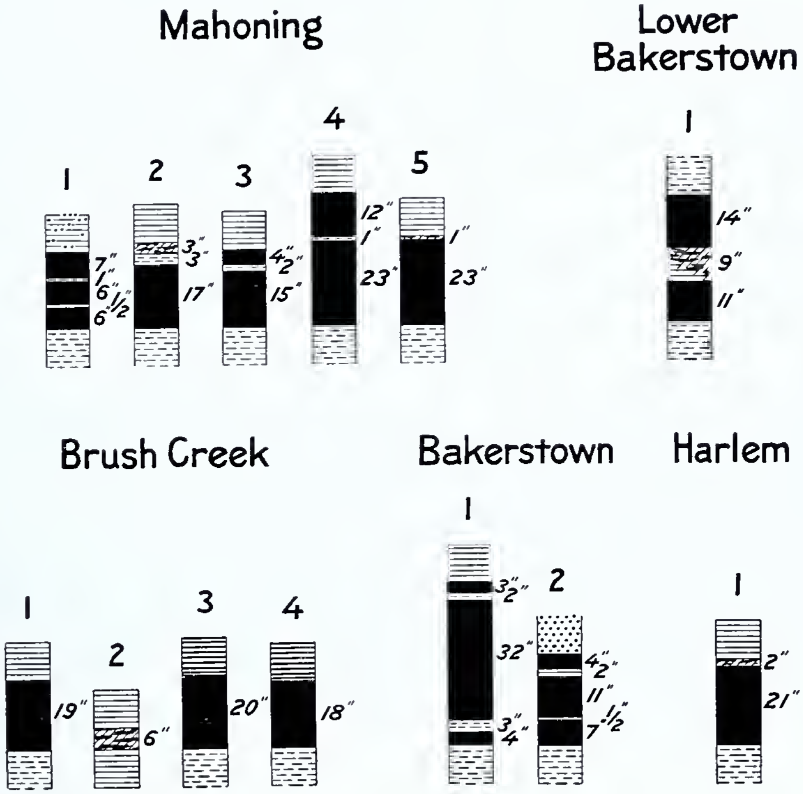

Figure 121. Sections of Conemaugh coals.

Mahoning coal: 1. Me3. 2. Nf5. 3. Mf6. 4. Lg1. 5. Nj2.
Brush Creek coal: 1. Lh8. 2. Oj1. 3. Nk1. 4. Nk3.
Lower Bakerstown coal: 1. Me5.
Bakerstown coal: 1. Lg3. 2. Pi2.
Harlem coal: 1. Nk4.

CONEMAUGH COALS

Of the coal beds in the Conemaugh formation, only the Mahoning, Brush Creek, Lower Bakerstown, Bakerstown, and Harlem coals were observed to attain local mineable thicknesses. These beds are generally too thin to be mined even for local custom coal. They are, however, persistent throughout their area of occurrence. The Mahoning bed is from 8 to 35 inches thick and commonly contains a thin clay parting in the upper half. The Brush Creek coal lies 120 feet above the Upper Freeport bed. It is usually less than 20 inches thick and contains clean coal. The Lower Bakerstown attains local thicknesses of 36 inches with a layer of bone coal or shale near the center of the bed. The Bakerstown coal is from 6 to 45 inches thick and consists of coal made dirty by several clay partings and numerous thin lenses of shale. The Harlem coal was observed only in the southeast corner of Henry Clay Township, where it is generally less than 24 inches thick.

Clay and Shale

Refractory clay beds that were mined in the past in this area are the Mercer of Pottsville time and the plastic underclay of the Brookville-Clarion coal at the base of the Allegheny formation. They were opened in the gorge of Youghiogheny River through Ligonier Valley. These two beds and the Lower Kittanning underclay, Bolivar flint clay, and Upper Freeport underclay all have persistent occurrences and generally have mineable thicknesses. They would probably be suitable for the manufacture of refractory articles. Along the Youghiogheny River they are easily accessible close to transportation facilities. The shale resources of the area are too numerous to discuss. Results of tests and analyses on the clay beds are given in the general chapter on clay and shale in this report.

Limestone

Several limestone beds in the area have potential value. The Loyalhanna formation is accessible along its line of outcrop on Laurel Hill and Chestnut Ridge and is suitable material for crushed stone, road metal, and paving block. It is from 30 to 55 feet thick. The Greenbrier limestone, from 10 to 25 feet thick, has been opened in small quarries for agricultural stone and road metal. In the Allegheny formation only the Upper Freeport limestone is sufficiently thick to be opened. In Stewart Township it reaches thicknesses of 6 feet. The Ewing and Clarksburg limestone beds of the Conemaugh formation have been opened at several places in eastern Henry Clay Township. The material was used for agricultural stone.

Sandstone

The many beds of sandstone that occur through the three townships could probably supply material suitable for sand of many uses or sandstone. The persistent thick beds are the Pocono, Connoquenessing, Homewood, Clarion, Westernport, Mahoning, Saltsburg, and Morgantown. Material from several of these beds has been used for road metal. More detailed information will be found in the general chapter on sandstones.

Sand and Gravel

Large deposits of sand and gravel were observed in the present flood plain of the Youghiogheny River in the Turkeyfoot Valley. Suitable material for concrete aggregate can be obtained easily from these deposits. Much of the sand appears, from visual observation, to be suitable for use as a molding sand.

Oil and Gas

Up to the present time there has been no production of oil or gas in the area under discussion. However, the discovery of natural gas in the deep-lying Onondaga sand at Summit on Chestnut Ridge has enhanced the possibility of finding gas in the area. From the structure map, the most favorable places are the several "highs" along the axis of Laurel Hill anticline.

WHARTON TOWNSHIP

Wharton Township lies in the central southern part of Fayette County and is its largest township. It extends east about 10 miles from the crest of Chestnut Ridge and from the West Virginia State line it extends north about 13 miles to the region known as Paul Flats.

Most of the area is drained southward to Cheat River by Big Sandy and Little Sandy Creeks. Meadow Run and Dunbar Creek drain the north part of the township to the Youghiogheny River. These streams and their tributaries flow for the greater part of their courses through steep-sided valleys with narrow bottoms. North of the National Pike, the stream valleys are relatively wide and have gentle slopes. The topography of the township is generally rugged. In the west part, the slopes of Chestnut Ridge are deeply notched by the headwaters of numerous streams. The remainder of the area lies in the Ligonier Valley, where the streams have cut deep valleys from 300 to 400 feet below the tops of the hills. The hilltops in the Ligonier Valley, some of which are flat, are in general between 1,900 and 2,200 feet altitude. The topography is less rugged south of Elliottsville and north of the National Pike.

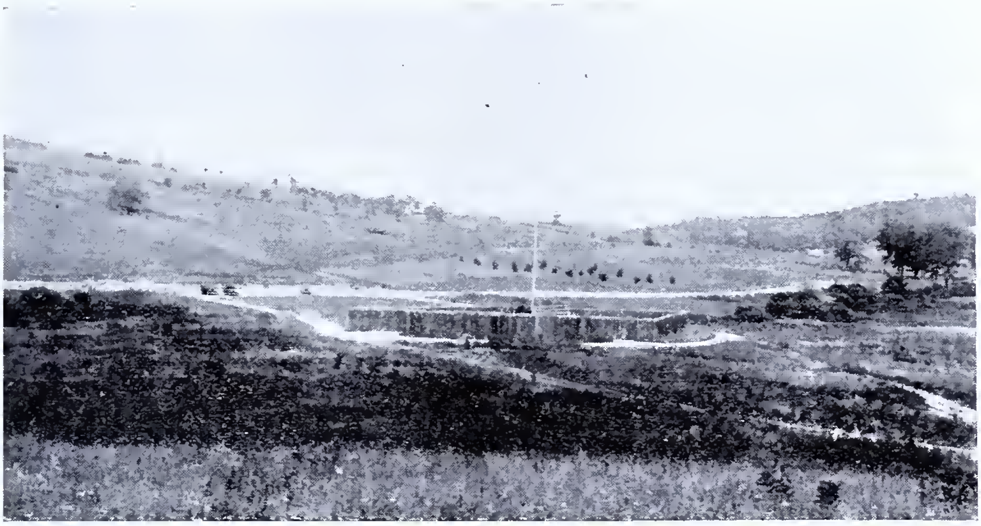

Figure 122. Fort Necessity, on National Pike west of Farmington.

The area has no railroads; transportation is dependent on the highways, especially on the National Pike. This road cuts across the northern part of the township in a southeast-northwest direction. Chief industries of the area are farming and lumbering. The coal resources have never been worked commercially because of the lack of shipping facilities.

West of Farmington is Fort Necessity, scene of the Battle of Great Meadows in 1754. The fort was reproduced in 1936 by the Federal Government.

Structure

Wharton Township lies in the general synclinal basin between Chestnut Ridge and Laurel Hill anticlines. To the northeast, this basin consists of a single pronounced syncline forming the Ligonier Valley, but in the eastern two-thirds of Wharton Township it consists of several minor synclinal and anticlinal structures. None of these is continuous through the area. The most pronounced structural feature is the steep west limb of the Ligonier syncline which occupies the western third of the township and forms the slopes of Chestnut Ridge.

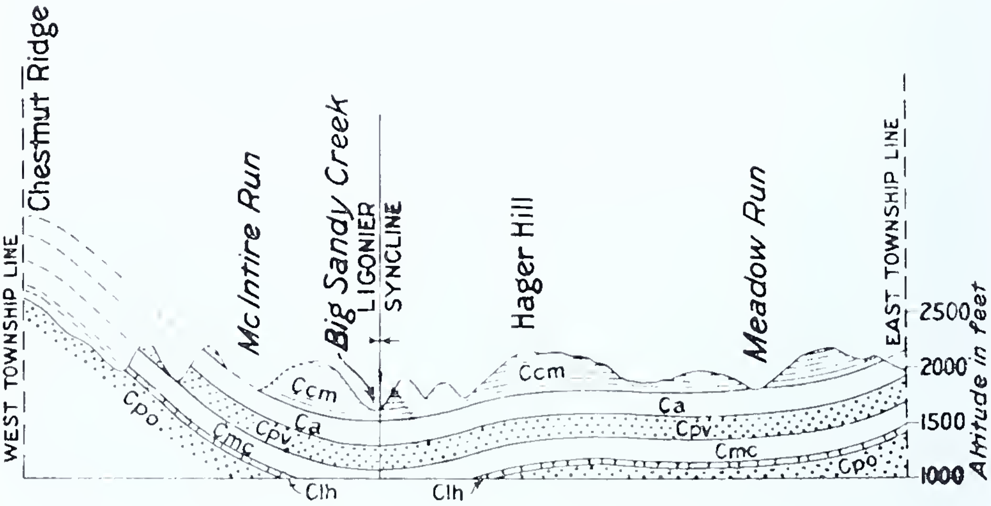

Figure 123. Structure section across Wharton Township.

Legend: Ccm—Conemaugh formation; Ca—Allegheny formation; Cpv—Pottsville formation; Cmc—Mauch Chunk formation; Clh—Loyalhanna formation; Cpo—Pocono series.

Here the strata rise at a maximum rate of about 1,000 feet per mile to the axis of the Chestnut Ridge anticline, which roughly follows the western boundary of the area. Maximum amplitude between the axes of the Chestnut Ridge anticline and the Ligonier syncline is about 2,000 feet. The axis of Ligonier syncline enters the county at Big Sandy Creek and follows a north-northeast course, passing near Elliottsville and Braddocks Grave. Just north of the National Pike, this branch of the syncline assumes a northward course and peters out near the northern boundary of the township. The main structure of the Ligonier syncline is broken in two parts and offsets about three miles to the east by the well-marked spur of the Chestnut Ridge anticline. This spur, which also slightly offset the main Chestnut Ridge anticline, has a southward course in Wharton Township. It extends from the north township boundary as far south as the National Pike, where it terminates in a small dome in the vicinity of Hager Hill. The main structure of the Ligonier syncline starts again along Meadow Run just north of Farmington and continues northeastward to and beyond the township line. In both sections of the syncline, the bottom is wide and flat and the east limb had a low inclination. North of Elliottsville, the east limb rises towards the axis of the Laurel Hill anticline, but along the southern boundary the strata roll through several structures. In Wharton Township, these structures represent the ends of anticlines and synclines that attain their best development in West Virginia. They lose their identity in a short distance north of the State boundary and are only minor structures in the area. East from the Ligonier syncline, they are named, in order, the Preston anticline, the Kingwood syncline, the Five Forks anticline, and the Glade syncline. The last of these enters the township at the extreme southeast corner.

The top of the Upper Freeport coal bed is used as the structural contour horizon. Contour intervals of 50 feet are used because in most places east of Chestnut Ridge in Fayette County information on the underlying structure is not sufficient to permit the use of smaller intervals.

Stratigraphy

Consolidated strata that crop out in Wharton Township comprise a total stratigraphic interval of about 1,750 feet and range in age from Upper Conemaugh time (Carboniferous) to post-Chemung and Chemung time (Devonian). The older strata are exposed along the slopes of Chestnut Ridge and the younger strata in the hilltops east of the ridge.

DEVONIAN

Chemung and post-Chemung strata. Rocks of Devonian age are believed to crop out as small "windows" in the deep notches cut into the side of Chestnut Ridge by Quebec, Long, Piney, Laurel, and McIntire Runs. These areas of outcrop are concealed by float rock and vegetation, and were not observed during field work. They are inferred from the structure, using formational thicknesses that were determined elsewhere in the county. A small area of outcrop of Chemung and post-Chemung strata extends eastward across the gap on Chestnut Ridge at Summit. As determined from the rock structure, the maximum thickness of these rocks above drainage is about 200 feet.

MISSISSIPPIAN

Pocono series. The Pocono strata are exposed along the western edge of the township, where they cap Chestnut Ridge and extend 1 to 1½ miles eastward down the spurs and hollows of the ridge. Only short stratigraphic sections are exposed at any locality and details of the character of the strata cannot be given. Generally it may be said that the strata are decidedly sandy. The beds observed and the float rock are medium-bedded to massive, gray, coarse-grained sandstones. Numerous beds of conglomerate with white quartz pebbles up to ¾ inch are present. The total thickness could not be determined in the township, but it is probably about 300 feet as measured at nearby localities.

Loyalhanna formation. The Loyalhanna formation has a sinuous outcrop that extends up and down the spurs and hollows on the slopes of Chestnut Ridge. North of High Point School, it caps several small knobs on the crest of the ridge, and south of this point its outcrop extends across the ridge's crest in an unbroken line at several places. It also caps one or two knobs and crosses the crest of Chestnut Ridge north of Summit. The formation is a dense, homogeneous, gray siliceous limestone that is highly cross-bedded. This bedding is very pronounced on weathered outcrops. The thickness of the formation could not be measured, but observations limit it between 25 and 65 feet. It appears to thin from north to south.

Mauch Chunk formation. The Mauch Chunk formation has a narrow outcrop on the slopes of Chestnut Ridge between Washington Springs and High Point School. North of Washington Springs, it caps Chestnut Ridge for a short distance and forms the valley sides along the headwaters of Dunbar Creek. South of High Point School, it also caps or is found near the crest of the ridge as well as outcropping on the slopes. The formation consists of three parts, which have a total thickness of about 200 feet. The lower part consists of red and green shales with several thick beds of green to brown medium-bedded, micaceous sandstone. It is from 20 to 50 feet thick. The Greenbrier limestone or middle member is 25 feet thick in the northern township corner, 30 feet at the National Pike, and about 40 feet thick in the Wymps Gap region. This is the greatest thickness of this member in Fayette County. In Wharton Township, it consists of a massive limestone bed 15 to 25 feet thick that is overlain by a series of thin limestone and gray shale beds. The upper member of the formation consists of red and green shales and sandy shales with minor amounts of green and brown, micaceous sandstones. It is less sandy than the lower member.

PENNSYLVANIAN

Pottsville formation. The Pottsville formation occurs along the slopes of Chestnut Ridge and caps the crest in the northwest and southwest township corners. Outcrops of massive members form cliffs. Float rock of these durable beds effectually conceals the softer members so that complete sections of the formation were not found. Generally three members were recognized, the Connoquenessing at the base, the Mercer group in the middle, and the Homewood at the top. The Connoquenessing and Homewood members have approximately the same thickness (80 feet) and are composed chiefly of massive, gray to buff, coarse-grained sandstone beds. Both members contain layers of conglomerate. The Mercer group, about 40 feet thick, is black to drab shales with some thin sandstone beds. The Mercer coal is a thin but persistent bed. The formation in Wharton Township is believed to be about 200 feet thick.

Allegheny formation. Strata of the Allegheny formation are exposed along the foothills of Chestnut Ridge. In the central, southern, and eastern parts of the township they are exposed only along streams. The thickness of the formation is between 200 and 225 feet. The

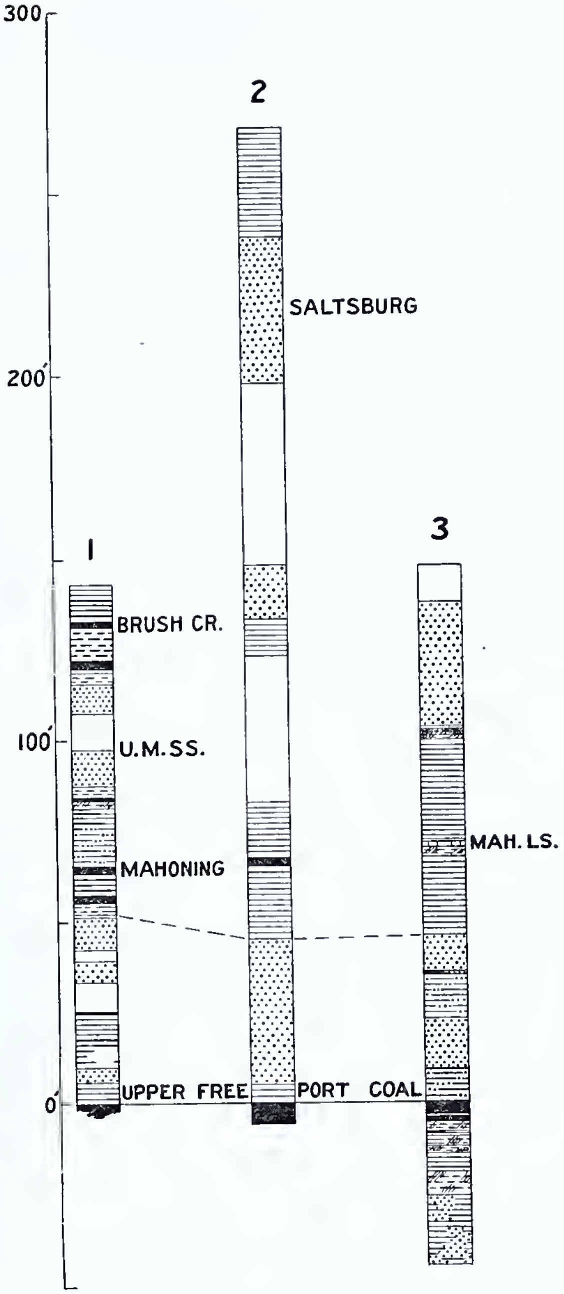

Figure 124. Stratigraphic sections in Wharton Township.

1. Section of the lower Conemaugh formation in road cut (Ki) one mile north of Farmington.

2. Composite section of lower Conemaugh formation along National Pike east of Farmington as measured by J. J. Stevenson, Pennsylvania Second Geol. Survey, Report KKK, p. 72.

3. Section of the upper Allegheny and lower Conemaugh formations in diamond drill hole on O'Neil farm (Jk), 2½ miles southeast of Elliottsville.

western outcrops may have subnormal thickness as on the west slopes of Chestnut Ridge, but definite proof in Wharton Township is lacking. The Brookville-Clarion coal at the base of the formation is a persistent bed that is overlain by the equally persistent Clarion sandstone. This sandstone is medium- to heavy-bedded and coarse-grained. The persistent Lower Kittanning coal and clay, which lie a short distance above the Clarion sandstone, are overlain directly by dark shale of variable thickness. The Westernport sandstone is commonly present as thick- to medium-bedded drab sandstone. The interval between the Westernport member and the Upper Freeport coal consists generally of a shale and clay series with local developments of sandstone beds at the horizons of the Freeport and Butler members. In this interval the Upper Kittanning and Lower Freeport coal beds are believed to be persistent. The Upper Freeport coal at the top of the formation is usually present as a bed of mineable thickness.

Conemaugh formation. Strata of the Conemaugh formation form the outcropping rocks over most of the eastern two-thirds of Wharton Township. They are the youngest rocks exposed in the area and the maximum thickness remaining uneroded is about 600 feet. The Mahoning member at the base of the formation is generally present as a medium- to heavy-bedded, coarse-grained, gray to buff sandstone. Locally the lower part is replaced by drab shale. The upper part contains fair amounts of sandy shale and is not so regular as the lower part. The Mahoning coal near the middle of the member is persistent through the area and is generally associated with clay, limestone, and red shale beds. The Brush Creek coal and associated black shales are commonly present and are overlain by an irregular occurrence of the Buffalo sandstone, of which the lower part is replaced by the Meyersdale red shale. The Lower Bakerstown or Thomas coal and the Cambridge limestone, lying about 180 feet above the base of the formation, are well developed in Wharton Township. They are overlain at a short interval by the Saltsburg sandstone, which is usually well developed. Locally, most or all of this sandstone may be replaced by shale. A series of red, green and yellow shales with thin lenses of sandstone overlies the Saltsburg sandstone and these shales in turn are overlain by the Morgantown sandstone, which is the youngest member of the formation remaining in the township.

East of Chestnut Ridge, the Conemaugh formation is thicker than it is west of the ridge. The increase appears to occur gradually above the Lower Bakerstown coal bed. Hence, the base of the Morgantown sandstone in the Ligonier Valley lies about 500 feet above the base of the formation as compared with 425 feet on the Fayette anticline west of Chestnut Ridge.

Coal Resources

None of the coal beds of Wharton Township have been developed commercially, but several of the beds in the Allegheny and Lower Conemaugh formations have been opened at many places for local custom coal. Information on the Mercer coal is meager, but the few observations indicate that it is not of mineable thickness in the area. Workable beds are the Brookville-Clarion, Lower Kittanning, Upper

Kittanning, Lower Freeport, and Upper Freeport coals of the Allegheny formation and the Mahoning, Brush Creek, and Lower Bakerstown coals of the Conemaugh formation.

In the following table, intervals between coal beds of Allegheny age apply to the normal thickness of 200 to 225 feet of the Allegheny as it occurs through most of Wharton Township.

Intervals to the Upper Freeport coal bed in Wharton Township, in feet

Coal	Average	Range
Conemaugh formation		
Lower Bakerstown	180	170 to 190
Brush Creek	115	110 to 130
Mahoning	60	40 to 70
Allegheny formation		
Upper Freeport (top)	0	0
Lower Freeport	45	35 to 50
Upper Kittanning	105	100 to 110
Lower Kittanning	160	155 to 175
Brookville-Clarion	210	200 to 225

Along the slopes of Chestnut Ridge, the intervals between coal beds of the Allegheny formation would probably be similar to those listed in the discussion on North and South Union townships. There the Upper Freeport-Lower Kittanning interval averages 105 feet and the Upper Freeport-Brookville-Clarion interval averages 165 feet.

ALLEGHENY COALS

All of the Allegheny coals are exposed along the slopes of Chestnut Ridge and in the southeastern corner of the township. In the rest of the area, only the upper beds crop out in some of the deeper valleys. Of the Allegheny coals, only the Middle Kittanning bed lacks mineable thickness at any point of observation.

Brookville-Clarion or A coal. The Brookville-Clarion coal was observed at many points along the slopes of Chestnut Ridge. Its only other area of outcrop in the township as inferred by structure and interval is along Little Sandy Creek at the eastern boundary just south of the National Pike. The coal is believed to be persistent through the area at an average interval of 210 feet below the Upper Freeport coal. Detailed sections could be measured at only two localities, near Chalkhill. Here the bed is from 5 to 8 feet thick and is a double-benched bed containing coal of fair quality. A clay parting from 6 to 15 inches thick occurs just below the middle of the bed and separates the upper and lower benches. The upper bench frequently has a layer of bone coal at the top and bottom and generally is composed of less acceptable coal than the lower bench. Knife-edges of shale and pyrite are common. The lower bench is from 20 to 30 inches thick and contains rather clean coal. Gray plastic clay forms the floor of the bed and a variable thickness of gray to drab shale forms the roof. The well-developed Clarion sandstone, lying a short interval above the coal, frequently cuts down and replaces the intervening shale and some of the coal.

Lower Kittanning or B coal. The Lower Kittanning coal lies 155 to 175 feet below the Upper Freeport and apparently is persistent in

Wharton Township at mineable thicknesses. It is from 30 to 48 inches thick and consists of clean coal in all except the top 1 to 6 inches. This top layer is interstratified coal and black shale. The bed does not have any persistent binders and shows only a few scattered pyrite balls. A characteristic dark to gray shale from 10 to 20 feet thick overlies the coal and forms a good roof. Gray plastic clay underlies the bed.

Upper Kittanning or C′ coal. This coal is workable only in the southern part of the township along the State line. Through the remainder of the area it appears as a thin but persistent bed that lies about 105 feet below the Upper Freeport coal. Along the State line, the Upper Kittanning bed is from 24 to 48 inches thick. It is broken by two to five partings of clay or shale that are from ½ to 5 inches thick, and it contains rather dirty coal. The roof is generally drab sandy shale or thin-bedded sandstone, and the floor is black shale or clay.

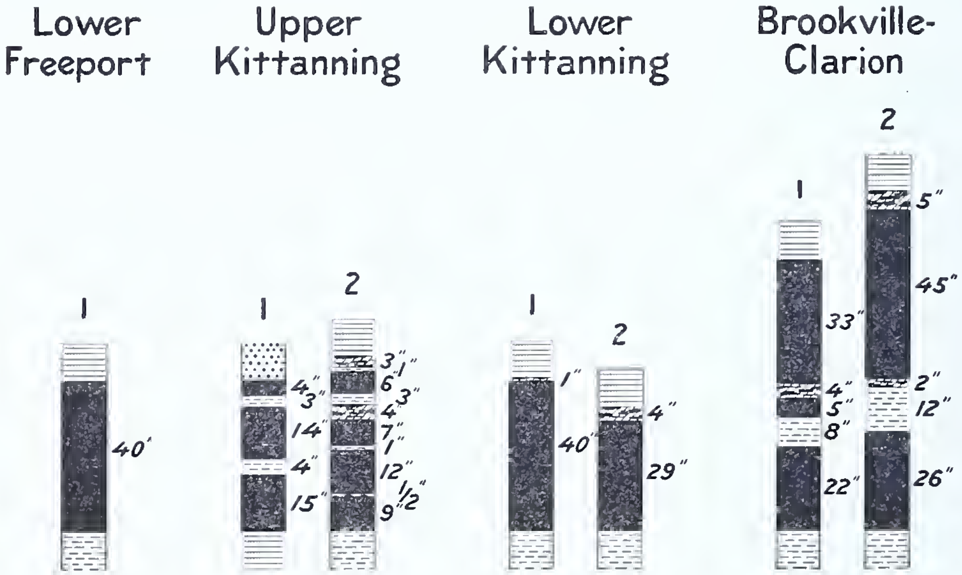

Figure 125. Sections of Allegheny coals in Wharton Township.

Lower Freeport coal: 1. Ij1.
Upper Kittanning coal: 1. Hk2. 2. Kk3.
Lower Kittanning coal: 1. Ih6. 2. Ii1.
Brookville-Clarion coal: 1. Ih4. 2. Ih5.

Lower Freeport or D coal. The Lower Freeport bed lies at an average interval of 45 feet below the Upper Freeport coal. Although seen at numerous localities, it was observed to be mineable at only one point (Ij1), in the southwestern corner of the area. Here it is 40 inches thick, but this is believed to be an exceptional development. The correlation is also somewhat doubtful. The bed in Wharton Township is overlain by a black to dark shale and is underlain by a gray clay.

Upper Freeport or E coal. The Upper Freeport coal has a persistent occurrence through the area as a mineable bed from 2 to 9 feet thick. Generally, the greatest thicknesses occur along the western outcrop and in the central part of the township. The smaller thickness occurs in the eastern and southern parts of the area, but in the southern part the thickness varies greatly in short distances. The bed contains only one persistent parting of clay from 1 to 18 inches thick near the base, but generally there are several non-persistent partings or binders of clay, shale, or bone. These sporadic partings are from ½ to 6 inches thick and have no definite horizon, but occur at any place in the bed. The coal is fairly clean, but locally the top portion may become a bone coal. Lenses and balls of pyrite in some exposures are numerous in the top part of the bed and near the persistent parting at the base. The floor is gray plastic clay and the roof is normally a dark to gray shale. The Mahoning sandstone, which lies a short distance above the coal, replaces frequently the intervening shale and rests directly on the coal over large areas.

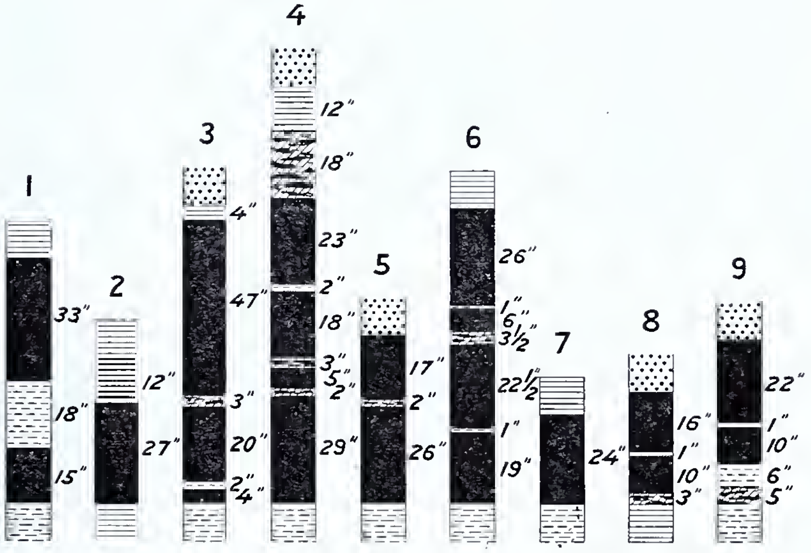

Figure 126. Sections of Upper Freeport coal in Wharton Township.

1. Ki1. 2. Kj4. 3. Jj4, Carrol custom bank. 4. Ij2. 5. Hk2. 6. Ik1. 7. Jk7. 8. Kk1. 9. Kk2.

CONEMAUGH COALS

Coals of the Conemaugh formation underlie the eastern two-thirds of Wharton Township and some of them in the lower part of the formation have been mined for custom coal. Only three, the Mahoning, Brush Creek, and Lower Bakerstown, were observed to attain workable thicknesses. The other Conemaugh coal beds are thin and apparently occur irregularly.

Mahoning coal. The Mahoning coal has a persistent occurrence in Wharton Township at an average interval of 60 feet above the Upper Freeport coal. It reaches mineable thickness in the region south of the National Pike along the headwaters of Stony Run and in the southeast corner of the township. Along Stony Run, the bed is from 36 to 66 inches thick, but contains a persistent binder of clay or bone just below the middle of the bed. Besides this binder, which is from 2 to 15 inches thick, the top 2 to 12 inches of the bed consists frequently of bone coal. The rest of the bed is clean coal with scattered occurrences of pyrite balls or lenses. In the southeast corner of the township, along Feik Run, one detailed observation (Lk1) shows the bed to be 53 inches thick with a clay parting 16 inches thick at the middle. Through all other parts of Wharton Township, the bed was observed to range in thickness between 6 and 20 inches and to contain one or two thin partings of clay or bone coal. The floor of the bed is gray plastic clay and the roof is a gray shale or clay shale that tends to soften after exposure to air.

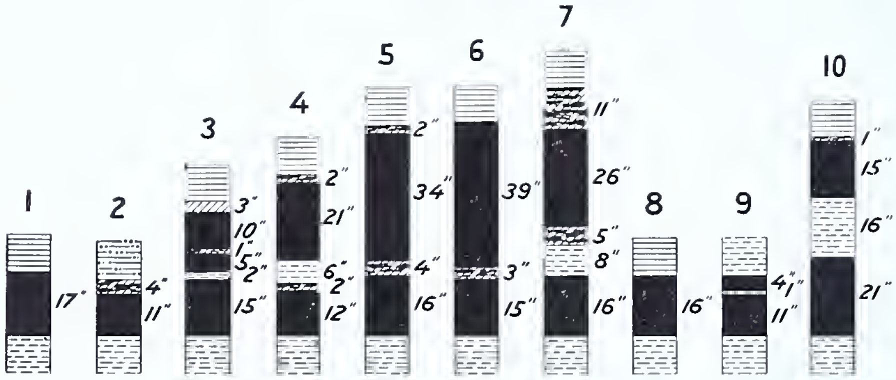

Figure 127. Sections of Mahoning coal in Wharton Township.

1. Ki2. 2. Ki4. 3. Kj2. 4. Kj3. 5. Kj5. 6. Kj6. 7. Kj7. 8. Jk2. 9. Jk3. 10. Lk1.

Brush Creek coal. The Brush Creek coal bed, lying about 115 feet feet above the Upper Freeport coal, occurs persistently in Wharton Township. It was observed to be mineable only locally. In the road cut half a mile north of Farmington, two coal beds separated by 9 feet of dark shale were observed at the Brush Creek horizon. The lower of these beds apparently has a very local habit, as it was not observed at any other locality. Observations show the Brush Creek coal to be from 12 to 30 inches thick and to contain fairly clean coal free of partings. Gray clay underlies and dark to black shale overlies the bed.

Lower Bakerstown coal. The Lower Bakerstown coal generally has mineable thickness in the central part of the township between Farmington and Elliottsville, where it is separated by 1 to 5 feet of gray clay from the underlying Cambridge limestone. The combination is favorable to the local farmers, who are able to obtain from one opening limestone for agricultural purposes and coal to burn it. The coal lies approximately 180 feet above the Upper Freeport coal and has a persistent occurrence. Where mineable it is from 18 to 40 inches thick and consists of clean coal in all except the top 1 to 10 inches, which usually is bone coal. Near Elliottsville, this top layer of dirty coal is separated from the clean coal by ½ to 3 inches of clay. At places the entire bed is clean coal that appears to be free of pyrite lenses. The roof of the bed is gray shale that requires a minimum of support. The Lower Bakerstown coal is the uppermost bed of mineable proportions in the township.

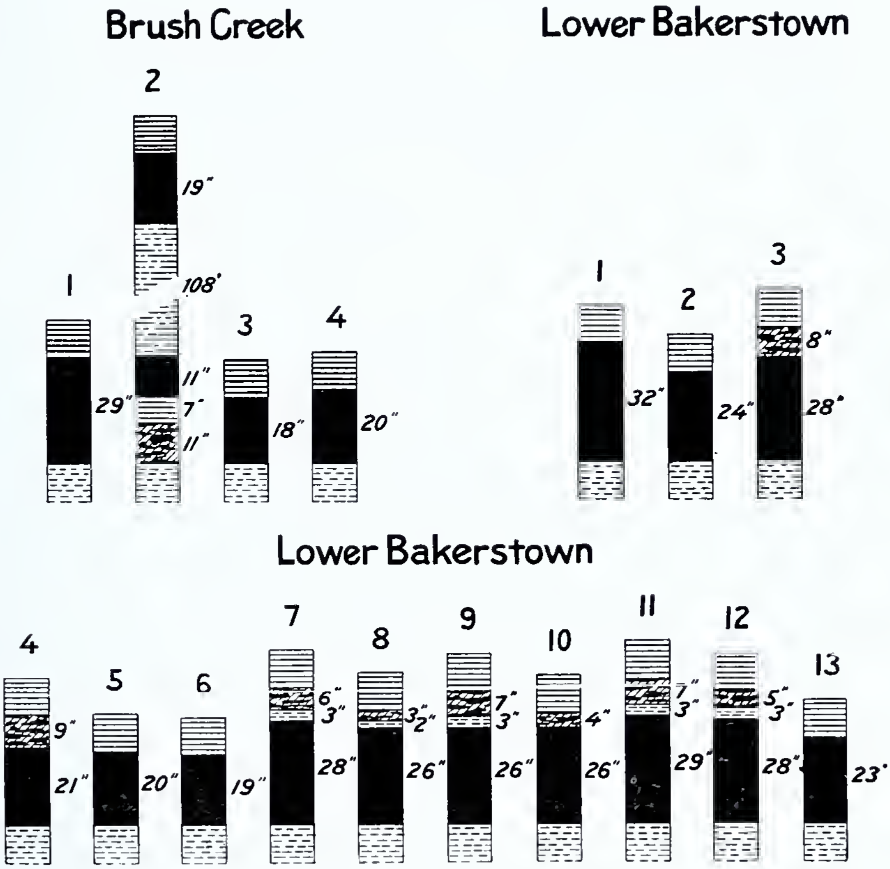

Figure 128. Sections of Conemaugh coals in Wharton Township.

Brush Creek coal: 1. Ji1. 2. Ki3. 3. Ij3. 4. Jk5.
Lower Bakerstown coal: 1. Ji6. 2. Ji2. 3. Ji3. 4. Ji4. 5. Ji5. 6. Ki5. 7. Jj1. 8. Jj2. 9. Jj3. 10. Jj5. 11. Jj6. 12. Jj7. 13. Jk6.

Clay and shale

The clay and shale resources of Wharton Township have never been developed commercially. Shale beds underlie all parts of the area and at least some of these would be suitable for manufacture of common and face brick. Refractory clay beds of the Allegheny and Lower Conemaugh formations are exposed through the area and several are up to 10 feet thick. Results of tests and analyses of several shale and clay beds are listed in the general chapter on clay and shale.

Limestone

Several persistent beds of limestone in the township have been worked at places for local use. The only commercial operation was on the Greenbrier limestone where it crosses the National Pike one mile west of Chalkhill. Here the bed consists of a massive-bedded limestone 22 feet thick that is overlain by 10 feet of interbedded limestone and gray shale. To the south, the Greenbrier limestone increases in thickness and reaches a total thickness of 40 feet in the southwest township corner. The Loyalhanna siliceous limestone and the Allegheny limestone beds have not been opened. In the Conemaugh formation, the Mahoning limestone is up to 4 feet thick and has been used for agricultural stone in the vicinity of Gibbon Glade. The Cambridge limestone from 2 to 5 feet thick has been opened at many places between Elliottsville and Farmington in conjunction with the Lower Bakerstown coal bed. The stone is used for agricultural purposes. Details on the limestone beds of Wharton Township are given in this report.

Sandstone

Although sandstone beds occur in all parts of Wharton Township, they have been worked only to supply stone for very local use on the roads or as building stone. Quarries are small and are worked only long enough to obtain sufficient stone for the desired purpose. In many cases, float rock or loose material has been picked from the fields and used. The more important beds of sandstone in the township are the Pocono, Connoquenessing, Homewood, Clarion, Mahoning, and Saltsburg. All of these contain hard, durable light gray to light brown sandstone. They are persistent beds and appear to be suitable for road metal or building stone. In addition, such arenaceous strata as the Buffalo sandstone occur locally as weather-resisting beds that appear suitable for the foregoing uses. Detailed information on several of the sandstones in Wharton Township is presented in the general chapter of this report on sandstones.

Oil and gas

The occurrence of oil and gas in Wharton Township is believed to be limited to the extreme western part along the Chestnut Ridge anticline. Here gas production has been obtained at or near the Onondaga chert, which lies about 6,500 to 7,000 feet below the crest of Chestnut Ridge. In the rest of the area, occurrences of oil or gas are believed to be highly improbable because of the unfavorable structural conditions. The small dome just west of Farmington might be an exception to the preceding general statement, but, even here, the effective closure of the dome is small and only a limited reservoir area is provided. However, it must be remembered that the possibility of finding oil or gas in or on the slopes of synclines in Pennsylvania is always present. A detailed description of the gas fields on Chestnut Ridge, south of Summit, will be found in the chapter on that subject.

PART III. MINERAL RESOURCES

HISTORY OF COAL AND COKE IN FAYETTE COUNTY

The earliest written record of coal in the region west of the Allegheny Mountains is in the journal kept by Colonel James Burd, during 1759, while he was opening a road from Braddocks Road at Gist's plantation (near Mount Braddock) to the Monongahela River at the mouth of Dunlap Creek. Going from Gist's plantation westward toward the Monongahela, he camped on Coal Run on September 22, 1759, and entered in his journal under that date the following excerpt:

> "Saturday, September 22, 1759.
>
> The camp moved two miles to Coal Run. The run is entirely paved in the bottom with fine stone coal, and the hill on the south of it, is a rock of the finest coal I ever saw. I burned about a bushel of it on my fire."

His notes of the following day fix the camp's location at a point two and a half miles from the Monongahela River. The fact that Colonel Burd speaks of the stream as Coal Run would indicate that the coal had been known at a previous date.

The early history of coke in both England and this country is more or less confused. In 1735, Darby is reported to have used coke successfully at Coalbrookdale in Shropshire, England; but little was accomplished until 1750, when it came into use as a blast furnace fuel. The various histories on Fayette County are generally agreed that Isaac Meason, in 1816 and 1817, constructed a rolling mill at Plumsock (near Upper Middletown), Fayette County, and that the first manufacture and use of coke in the county was at this iron mill when it was put in blast in September, 1817. One historian cites an account of the first manufacture and use of coke in the United States, at Allegheny Furnace, Blair County, in 1811; other historians place the credit on Meason's furnace in Fayette County in 1817, at which time it is reported that coke was made at Plumsock, in ricks, from Redstone coal. The resulting coke was not satisfactory and coke manufacturing at this furnace was abandoned. An Englishman named Nichols, reputed to have made coke at Durham, England, was responsible for the experiments at Meason's Furnace.

After the failure, Nichols came to Connellsville, where he was put in charge of Lester L. Norton's iron furnace. After inducing Norton to try to make coke, Nichols designed an oven of the regular beehive type to make 24- and 36-hour coke. The oven was 12 feet square and was constructed of stone, with a hive of brick, by John Taylor, a stonemason, at a location on Connell Run near the South Side culvert in Connellsville. In 1833 the oven was charged with coal from the Plummer mine on the east bank of the Youghiogheny, just north of Connellsville, and the first coke was made in a beehive oven in this region. This venture evidently was successful, as Norton soon had to augment his oven production by making coke in ricks.

In 1836, F. H. Oliphant made coke in ricks at the Fairchance Furnace and used it to smelt iron from Blue Lump ore, the first ore bed under the Pittsburgh coal.

A partnership of Provance McCormick, James Campbell, and John Taylor was formed in 1841 for the purpose of manufacturing coke for sale at Cincinnati. Taylor, a stonemason, erected two ovens on his farm near Sedgwick Station, mined the coal on his farm and superintended the coking of the coal. McCormick and Campbell, who were carpenters, built two barges or flatboats to provide the transportation. Coke was made during the fall and winter of 1841, and in the spring of 1842 the partners had loads for the two flatboats, a total cargo of approximately 1,600 bushels (some historians state that the cargo was only 300 bushels). On a high stage of water that spring, the boats started and safely reached Cincinnati, where great difficulty was encountered in selling the unknown fuel. Historians are agreed that a patent iron grist mill, which later proved to be a failure when installed at New Haven, was accepted in trade for a part of the coke. The remainder of the cargo either sold in small lots for 8 cents a bushel or was traded for coffee and other goods. Some of the coke was used by foundry men around Cincinnati and was liked so well that representatives were sent to Connellsville to persuade the coke partners to make more of their product. However, all offers were refused, as the partners were completely discouraged by the failure of their first venture.

The ovens built by Taylor at Sedgwick were leased by James and Sample Cochran, with Mordecai Cochran as a possible third partner. The Cochrans manufactured 12,000 to 13,000 bushels of 24-hour coke (some sources give the amount as 1,300 bushels), which they boated to Cincinnati, leaving Connellsville April 1, 1843. The entire cargo was sold for seven cents a bushel cash to Miles Greenwood, a foundryman of Cincinnati, who had used part of the first coke shipment in his furnace. Because of the success of this venture, the Cochrans continued to make coke at what became known as the Fayette Works, and in 1860 the plant was enlarged to thirty ovens.

About 1844 or 1845 Alex Hill is reported to have first built four small beehive type ovens and shortly thereafter added eight more ovens, where the Thomas Gregg ovens were later constructed.

Stewart Strickler, in either 1846 or 1847, bought ten acres of coal near Jimtown and constructed six coke ovens. The coke was sold to the Cochrans. In 1855 Strickler bought 80 acres more of coal in the same neighborhood and when the Pittsburgh & Connellsville Railroad was built in 1857, he erected 80 ovens on his land and trammed the coke to the railroad for shipment to Pittsburgh.

Philo Norton purchased the Plummer mine and surface in 1855, and built four ovens on the east side of Mounts Creek, at Davidson Bridge. He also burned coal in ricks to augment his oven product. The coke was shipped by rail, Norton receiving three cents a bushel aboard the railroad cars.

An instance of the rapid increase in the value of the coal land in the Connellsville region, at this period, is the following: Between 1834 and 1840, Strickler purchased his father's farm for $30 an acre and in 1864 he sold the property to J. K. Ewing for $200 an acre, Ewing shortly afterwards selling the same coal land for approximately $400 an acre. These values applied only to hilltop coal, or coal which could be mined by drifts. The land on which the coal lay at greater depths so as to necessitate shaft mining, still had a low sale value.

After 1860 came the realization of the tremendous potential value of coke manufacturing, and the number of ovens was increased rapidly to meet the growing demand for coke. The following sequence lists all the early coking plants of Fayette County:

1855. 26 ovens were operated in the region.

1860. 30 ovens were built at Sedgwick.

1864. 40 ovens, known as the Jackson Works, were constructed on Hickman Run by Cochran and Keister.

1866. Connellsville Gas Coal Company built 40 ovens at Davidson and enlarged the plant in 1868.

1869. 40 ovens were erected at Watts Station, near Dunbar, by Watt, Taylor & Company.

1871. Henry Clay & Morgan coke works were built along the Mount Pleasant Branch of the B. & O. R. R.

1872. 100 ovens were constructed on the James Paull farm west of Dunbar by Paull, Brown & Co.

Other plants constructed in 1872 were the Mount Braddock Works of 100 ovens, the first Jimtown plant of 100 ovens, and the Valley plant of 50 ovens.

Expansion continued rapidly so that a total of 3,673 ovens had been constructed in the region until the panic of 1873 halted any further expansion and lowered the selling price of coke to less than $1 a ton. This lull continued until 1879, when the price of coke advanced to $5 a ton and renewed interest in the industry so that by 1880 there were 7,211 ovens in the region and the production was 2,206,000 tons of coke. In 1890, 15,865 ovens were in operation and the production advanced to 6,464,000 tons. By 1900, 20,981 ovens produced 10,021,000 tons of coke and in 1910 there were 24,481 ovens and the production was 11,460,000 tons of coke. This was the greatest number of operating ovens in the history of the Connellsville region. The peak of production for the region was in 1907, when 23,857 ovens produced 13,089,000 tons of coke. The decline of beehive coking was gradual until 1914, when the World War provided a temporary boom period that lasted through 1918, with a secondary peak of production in 1916, of 12,211,000 tons. By 1920 the number of ovens decreased to 19,245 and production fell to 7,135,000 tons. In 1930 there were 7,393 ovens and the production was only 272,000 tons. The record low for the region was in 1932, when 90,900 tons were produced by 6,538 ovens. The number of ovens is decreasing steadily so that in 1933 there were only 4,541 in an operating condition. Yearly statistics on the Connellsville region are given at the end of the chapter.

The development of the Lower Connellsville or Klondike region began in 1899, and during 1900 the 2,033 ovens in the region produced 385,909 tons of coke. In 1905 the output was 3,871,310 tons and in 1910 there were 14,805 ovens, which produced 8,219,000 tons. The peak of production for the Lower Connellsville region was in 1916, when 9,580,000 tons of coke were produced, and the greatest number of ovens in operating condition was in 1917, when there were 16,420 ovens. By 1920 the number of ovens was 15,146, and the production decreased to 5,008,000 tons. The decline continued so that in 1930, 6,236 ovens produced 1,145,000 tons, and in 1932 the record low production of 225,594 tons was established. The number of ovens in the region steadily decreased so that in 1935 there were only 2,576 in operating condition. Since then the number of ovens, production, and price has increased. Yearly statistics on the Lower Connellsville or Klondike region are given at the end of the chapter.

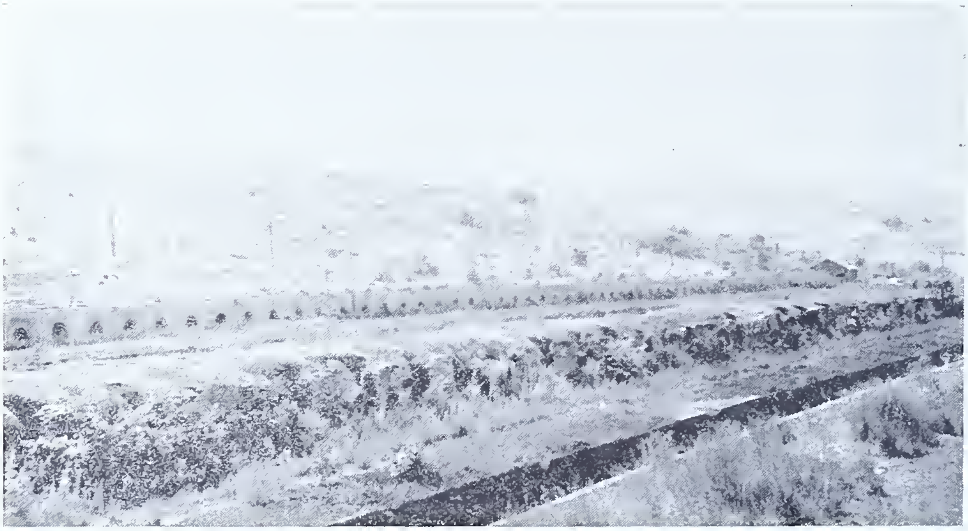

Figure 129. Abandoned beehive coke ovens near Star Junction.

In 1938 the mining activity of the Lower Connellsville region is far greater than that of the Connellsville region. The Lower Connellsville region, or so-called Klondike because of a fancied resemblance to the development of the Yukon Klondike, was pioneered by the Eureka Fuel Company, which constructed the Buffington, Footedale, and Leckrone plants; and the American Steel and Wire Company, which constructed the Gates, Lambert, and Edenborn plants. Ronco was built about 1901 by the Sharon Steel Company, and in 1906 the Thompson Connellsville Coke Company built Thompson No. 1 and No. 2. Development was very rapid in this district and in a relatively short time all the coal land in the Klondike was in some stage of development.

All the coke ovens in the Connellsville and Lower Connellsville regions were of the beehive type, with the exception of one plant, the Semet-Solvay by-product plant at Dunbar. Here 50 by-product ovens were constructed in 1896 and 60 additional ovens in 1903 and 1904. The plant used coal from the Pittsburgh bed and from the Upper Freeport bed, coking them either mixed or separate. Tar, ammonia, and light oil were recovered during the process and the surplus gas was sold to two neighboring industrial plants. The coke was sold to the Dunbar Furnace Company until that company ceased operations and after that the coke was crushed and sent west for domestic sale. This by-product plant ceased operations in February, 1924, and was dismantled.

There are two general types of beehive ovens in the Connellsville region, the round beehive and the rectangular. The standard round beehive is 12 feet in diameter and about 7 feet high, and is constructed in either single or double banks. The rectangular oven was introduced in the region at the Mount Braddock plant in 1906 and is a larger oven than the round beehive, the rectangular oven taking a charge of 5½ tons as compared to a 4½-ton charge of the round oven. The standard rectangular oven is 30 feet long, 4½ to 5 feet wide and 8½ feet high, and is constructed in single banks with a door at each end. There is no difference in the coking process of the two types, but the rectangular is better adapted to mechanical drawing of the coke. The greatest development of rectangular ovens in the coke region was in 1914, at which time there were 1,132 ovens of this type in the Connellsville district and 2,666 ovens in the Lower Connellsville district.

The average yearly price of Connellsville coke did not vary to a great extent from the beginning of the industry until 1917, its range during this period being between $1 and $2.50 per ton. The war period and coal boom of 1920 advanced prices to a record high of $8.87 a ton in 1920—from which peak the prices declined gradually until 1932, when a low for the post-war period of $2.24 a ton was established. Spot prices of Connellsville coke, however, had considerable range; the prices varied from 70 cents per ton in times of depression, as during the panic of 1873, to $16 per ton during the war period of 1917. These price ranges are given irrespective of whether the coke was from the Connellsville or the Lower Connellsville region. The coke of the Connellsville region usually commands a slightly higher price.

It is interesting to note that the coke shipment of 1842 of McCormick, Campbell and Taylor was sold for approximately $4.40 per ton (8 cents per bushel) at Cincinnati, and the Cochran shipment of 1843 brought roughly $3.85 per ton (7 cents per bushel) at Cincinnati.

The coal production of Fayette County closely followed the course set by the coke industry, as nearly all the coal produced in the county is made into coke. In 1938 the greater part of the coal mined from the Pittsburgh bed was shipped out of the country and coked at by-product plants. The Pittsburgh bed is so remarkable that little attention is paid to the other mineable coal beds of the county until a coal boom or great increase in prices occurs. In the coal boom of 1917 to 1921 the Waynesburg, Sewickley, Upper Freeport, Lower Kittanning and Brookville coal beds were mined commercially, but as soon as the boom collapsed, mining activities in these beds virtually ceased.

In the Ligonier Valley, in the vicinity of Indian Head, development of the Lower Kittanning coal was started about 1913, when the Indian Creek Valley Railroad was constructed. Several companies are operating on this bed in 1938, although under the handicap of disposing of the mine water to prevent pollution of Indian Creek. The water-disposal difficulty began in 1920, and in 1922 the Indian Creek Valley Mine Drainage Company was formed by the interested coal operating companies to construct a flume that would carry the mine waters below the reservoir one mile south of Normalville, at which point the drainage waters may be discharged into Indian Creek.

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TABLE 1

COKE STATISTICS OF THE CONNELLSVILLE REGION*

Number of ovens, short tons of coal and coke produced, and value and price of the coke.

Year	Number of ovens	Coal used in coke manufacture (tons)	Yield of coke from coal (per cent)	Coke produced (tons)	Total value of coke produced (at ovens)	Average price per ton (at ovens)
1880	7,211	3,367,856	65.5	2,205,946	$3,948,643	$1.79
1881	8,208	4,018,782	65.7	2,639,002	4,301,573	1.63
1882	9,283	4,628,736	65.8	3,043,394	4,473,789	1.47
1883	10,176	5,355,380	66.3	3,552,402	4,049,738	1.14
1884	10,543	4,829,054	66.1	3,192,105	3,607,078	1.13
1885	10,471	4,683,831	66.1	3,096,012	3,776,388	1.22
1886	11,324	6,305,460	66.3	4,180,521	5,701,086	1.36
1887	11,923	6,182,846	67.0	4,146,989	7,437,669	1.79
1888	12,818	7,191,708	69.0	4,955,553	5,884,081	1.19
1889	14,458	8,832,371	67.0	5,930,428	7,974,633	1.34
1890	15,865	9,748,449	66.3	6,464,156	11,537,370	1.94
1891	17,551	7,083,705	67.0	4,760,665	8,903,454	1.87
1892	17,309	9,389,549	67.4	6,329,452	11,598,407	1.83
1893	17,504	7,095,491	67.7	4,805,623	7,146,031	1.49
1894	17,829	7,656,169	67.8	5,192,080	5,405,691	1.04
1895	18,028	12,174,597	67.2	8,181,179	10,122,458	1.237
1896	18,347	8,107,536	67.4	5,462,490	10,018,946	1.834
1897	18,467	10,243,690	67.0	6,860,826	10,662,428	1.55
1898	18,927	12,454,969	66.8	8,315,350	12,626,292	1.518
1899	19,294	14,974,018	69.4	10,390,335	17,075,411	1.64
1900	20,981	14,946,659	67.0	10,020,907	22,383,432	2.23
1901	21,586	15,266,722	67.0	10,235,943	19,172,697	1.873
1902	21,659	15,538,701	67.05	10,418,366	23,785,433	2.283
1903	22,563	13,498,859	67.4	9,102,391	20,707,442	2.27
1904	22,695	13,185,690	67.4	8,883,220	13,990,329	1.575
1905	22,033	16,980,341	66.9	11,365,077	22,315,361	1.96
1906	23,616	17,956,160	67.1	12,057,840	26,858,660	2.23
1907	23,857	19,751,739	66.3	13,089,427	30,355,050	2.32
1908	24,071	10,283,665	67.2	6,880,951	14,025,422	2.04
1909	24,422	17,581,899	66.9	11,769,758	23,379,149	1.99
1910	24,481	17,205,615	66.6	11,459,601	23,121,556	2.02
1911	23,879	14,420,328	66.3	9,565,013	18,471,506	1.93
1912	22,219	17,772,202	66.5	11,814,588	22,463,602	1.90
1913	22,189	17,379,314	66.6	11,566,778	25,830,382	2.23
1914	21,343	11,789,842	66.6	7,850,813	15,078,667	1.92
1915	21,389	14,540,251	67.1	9,763,677	18,213,750	1.87
1916	21,129	18,274,300	66.8	12,210,728	29,559,601	2.42
1917	20,974	15,388,687	66.5	10,230,909	40,392,051	3.95
1918	20,365	14,325,959	66.3	9,501,692	51,689,205	5.44
1919	19,825	10,454,353	65.5	6,844,561	30,937,416	4.52
1920	19,245	10,743,658	66.4	7,134,781	63,285,507	8.87
1921	16,719	3,309,159	67.1	2,219,547	11,425,864	5.15
1922	16,334	5,900,104	66.3	3,913,229	20,423,667	5.22
1923	15,341	11,411,725	66.4	7,580,817	44,079,103	5.81
1924	15,256	5,484,692	66.3	3,638,895	17,186,869	4.72
1925	15,333	6,470,819	66.3	4,291,429	19,525,302	4.55
1926	15,454	7,411,701	66.2	4,905,254	22,279,293	4.54
1927	15,055	3,851,813	66.3	2,552,024	10,615,657	4.16
1928	12,515	1,403,687	66.0	930,217	3,284,814	3.53
1929	10,056	2,241,830	63.7	1,428,227	5,115,645	3.58
1930	7,393	409,842	66.34	271,893	871,654	3.21
1931	6,764	252,665	67.04	169,378	502,157	2.96
1932	6,538	135,087	67.29	90,900	227,503	2.50
1933	4,541	191,044	66.12	126,313	318,376	2.52
1934	4,305	165,059	66.21	109,285	423,091	3.87
1935	4,355	149,057	66.64	99,338	385,185	3.88
1936	3,883	371,788	66.45	247,059	953,942	3.86
1937	2,983	1,355,627	66.15	896,749	3,593,349	4.01

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* Mineral resources of the United States, by United States Geological Survey, 1882-1923; by United States Bureau of Mines, 1923-1937.

TABLE 2

COKE STATISTICS OF THE LOWER CONNELLSVILLE OR KLONDIKE REGION*

Number of ovens, short tons of coal and coke produced, and value and price of the coke.

Year	Number of ovens	Coal used in coke manufacture (tons)	Yield of coke from coal (per cent)	Coke produced (tons)	Total value of coke produced (at ovens)	Average price per ton (at ovens)
1900...........	2,033	579,928	66.5	385,909	$792,886	$2.05
1901...........	3,251	1,666,826	66.9	1,116,379	1,991,699	1.784
1902...........	4,253	2,826,242	67.2	1,899,111	4,701,068	2.475
1903...........	5,753	3,452,568	67.5	2,329,298	5,522,884	2.37
1904...........	6,570	4,229,755	68.2	2,887,456	4,623,133	1.60
1905...........	7,484	5,666,812	68.3	3,871,310	7,523,382	1.95
1906...........	9,708	7,465,205	69.4	5,188,135	12,046,889	2.32
1907...........	12,264	9,150,693	69.0	6,310,900	15,758,049	2.50
1908...........	13,162	6,156,553	69.1	4,252,222	7,796,860	1.83
1909...........	14,215	9,871,803	69.1	6,761,335	12,490,518	1.85
1910...........	14,805	12,130,425	67.8	8,219,492	16,048,675	1.95
1911...........	14,857	10,771,495	68.3	7,354,736	12,998,192	1.77
1912...........	15,525	13,456,074	67.1	9,023,371	17,166,837	1.90
1913...........	15,736	13,498,088	66.5	8,976,781	19,868,322	2.21
1914...........	16,037	9,296,713	65.5	6,224,224	11,557,006	1.86
1915...........	16,400	11,930,691	67.0	7,989,862	14,359,435	1.80
1916...........	16,360	14,472,277	66.2	9,580,215	24,942,032	2.60
1917...........	16,420	12,785,016	65.3	8,348,727	40,499,332	4.85
1918...........	16,234	11,875,495	65.4	7,761,295	48,740,933	6.28
1919...........	16,300	7,297,405	67.6	4,933,368	23,532,165	4.77
1920...........	15,146	7,592,680	66.0	5,008,158	39,864,938	7.96
1921...........	13,426	2,451,640	67.1	1,645,373	7,163,360	4.35
1922...........	13,160	2,575,613	67.5	1,740,414	9,546,128	5.48
1923...........	12,557	8,739,859	65.4	5,719,608	32,312,919	5.65
1924...........	12,258	4,788,835	66.2	3,167,880	12,086,645	3.82
1925...........	11,552	5,058,370	66.7	3,372,377	13,568,195	4.02
1926...........	11,458	5,889,788	66.9	3,938,159	16,318,593	4.14
1927...........	11,158	3,518,905	66.3	2,333,515	8,083,885	3.46
1928...........	10,154	2,637,833	66.6	1,757,436	5,129,489	2.92
1929...........	7,882	3,985,720	68.0	2,710,221	7,787,124	2.87
1930...........	6,236	1,673,712	68.43	1,145,368	3,235,996	2.83
1931...........	5,176	682,913	65.58	447,883	1,064,163	2.38
1932...........	4,019	355,199	63.51	225,594	505,518	2.24
1933...........	3,913	525,285	62.97	330,752	749,316	2.27
1934...........	2,840	519,955	64.20	333,821	1,059,105	3.17
1935...........	2,576	389,552	64.69	251,984	815,723	3.24
1936...........	2,791	897,143	65.08	583,846	2,090,341	3.58
1937...........	3,001	1,659,105	66.09	1,096,426	4,427,136	4.04

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* Mineral resources of the United States, by United States Geological Survey, 1900-1923; by United States Bureau of Mines, 1923-1937.

TABLE 3

COAL STATISTICS OF FAYETTE COUNTY*

Year	Total coal produced (short tons)	Total value (at mine)	Average value per ton (at mine)
1880	2,356,983	$1,349,657	[1]
1881	[1]	[1]	[1]
1882	2,971,126	[1]	[1]
1883	[1]	[1]	[1]
1884	4,041,643	[1]	[1]
1885	3,192,972	[1]	[1]
1886	4,494,613	3,101,283	$0.69
1887	4,540,322	3,405,241	0.75
1888	5,208,993	[1]	[1]
1889	5,897,254	3,702,548	0.63
1890	6,413,081	4,931,015	0.77
1891	5,782,573	4,755,444	0.82
1892	7,260,044	5,620,159	0.77
1893	6,261,146	4,563,989	0.73
1894	6,440,989	4,472,578	0.69
1895	9,665,369	6,439,717	0.67
1896	8,076,200	5,394,481	0.67
1897	9,701,691	5,797,323	0.60
1898	12,696,063	7,778,959	0.61
1899	14,609,289	10,709,428	0.73
1900	15,055,042	14,284,688	0.95
1901	16,187,224	16,243,131	1.00
1902	18,988,058	18,930,437	1.00
1903	19,613,161	22,175,840	1.13
1904	19,231,011	16,585,466	0.86
1905	24,250,989	22,983,215	0.95
1906	27,044,451	27,141,727	1.00
1907	29,260,622	30,321,657	1.04
1908	19,474,417	19,707,839	1.01
1909	28,866,229	24,002,056	0.83
1910	31,097,233	31,210,480	1.00
1911	26,803,068	26,886,299	1.00
1912	32,366,567	32,595,749	1.01
1913	32,607,963	37,810,508	1.16
1914	23,336,180	24,495,859	1.05
1915	28,424,067	29,297,580	1.03
1916	34,249,848	42,151,087	1.23
1917	32,083,027	70,444,972	2.20
1918	32,925,888	72,818,426	2.21
1919	29,660,105	64,676,523	2.18
1920	30,742,236	100,482,000	3.27
1921	19,260,778	46,041,000	2.39
1922	17,759,776	49,876,000	2.81
1923	32,165,961	89,307,000	2.78
1924	25,432,133	57,081,000	2.24
1925	28,819,108	62,668,000	2.17
1926	32,755,937	71,412,000	2.18
1927	30,082,320	63,816,000	2.12
1928	29,564,103	58,783,000	1.99
1929	31,400,228	59,087,000	1.88
1930	23,830,852	42,607,000	1.79
1931	13,938,055	23,672,000	1.70
1932	8,374,764	11,916,000	1.42
1933	10,075,860	16,010,000	1.59
1934	11,927,582	23,676,000	1.99
1935	13,456,428	27,319,000	2.03
1936	19,564,591	[1]	[1]
1937	20,715,179[2]	[1]	[1]
1938	9,975,444[2]	[1]	[1]

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* Mineral resources of the United States, by United States Geological Survey, 1882-1923; by United States Bureau of Mines, 1923-1938.

[1] Data not available.

[2] Data from Mine Inspector's report, Pennsylvania Department of Mines.

COAL RESOURCES

In the following discussions of coal resources in Fayette County, only general descriptions of the coal beds that attain mineable thicknesses will be given. Each bed with its characteristics will be described separately on a county-wide basis. For detailed bed sections and descriptions of the coals, the reader is referred to the discussions on geology and resources by townships.

Beds of mineable thicknesses occur in the Pottsville, Allegheny, Conemaugh, Monongahela, and Dunkard formations. However, coal beds that have value commercially, at present or in the near future, are limited to the Allegheny and Monongahela formations. Under present economic conditions, the coal beds in the order of tonnage mined from each are: Pittsburgh, Sewickley, Lower Kittanning, Upper Freeport, Waynesburg and Brookville-Clarion coals.

The coals of Fayette County may be divided roughly into steam and gas grades; those obtained east of Chestnut Ridge are steam coals and those west of the ridge are gas coals. In the Uniontown-Connellsville basin, the coal is on the dividing line between the two grades and is equally suitable for use either as steam or gas coals.

The author of the data on coal resources wishes to express his sincere appreciation of the splendid cooperation from the coal operators, engineers and State mine inspectors in Fayette County for supplying information which contributed greatly to the value of this report. Messrs. C. A. McIntyre, of the H. C. Frick Coke Co.; A. J. Opperman, consulting engineer; W. B. Trimble, of the Indian Creek Coal Co.; R. Maize, Deputy Secretary of the Department of Mines of Pennsylvania; J. B. Moore, of the Fancy Hill Coal Co.; E. L. Messler, of the Eureka Fire Brick Co.; L. C. Campbell, of the Koppers Coke Co.; and officials of the Rainey Coal Co. all deserve special mention for the great amount of data they made available for the report. The writer is indebted to the following members of the Pennsylvania Geological Survey: Dr. R. W. Stone, who edited the complete report and gave valuable aid to the final form; M. N. Shaffner and J. Turner for the planimeter work necessary for computing coal reserves, and to Miss M. M. Johnstone for the final drafting of all figures that accompany the text.

Pottsville Coals

Only one bed in the Pottsville formation, the Mercer coal, reaches mineable thickness in Fayette County. It is of very minor importance as a coal resource because it has an extremely variable occurrence and was observed to be mineable over only small local areas. The Mercer coal lies just above the middle of the Pottsville formation in the Mercer group, which is composed chiefly of argillaceous sediments. It crops out along the slopes of Laurel Hill and Chestnut Ridge and is above drainage in the gorge of the Youghiogheny River through the Ligonier Valley. In this area of the outcrop, the coal has mineable thicknesses in northeast Bullskin Township near the crest of Chestnut Ridge and in central Henry Clay Township. In Bullskin Township the bed has a maximum thickness of 40 inches and is free of persistent binders.

The coal contains numerous thin lenses of shale and balls of pyrite, so that the ash and sulphur content probably are high. In central Henry Clay Township the Mercer coal attains a maximum thickness of 55 inches. It contains one persistent and several non-persistent partings of clay up to 2 inches thick near the base of the bed. The remainder of the coal contains numerous thin lenses or "knife-edges" of shale and balls of pyrite. In both townships the area of mineable coal is apparently of very local extent. Elsewhere in the county the Mercer coal bed has thicknesses under 18 inches and consists usually of dirty or bony coal.

Allegheny Coals

The coal beds of the Allegheny formation occur along the slopes of Laurel Hill and Chestnut Ridge, and in the Ligonier and Turkeyfoot valleys. West of Chestnut Ridge these coals are exposed above drainage only in the gorges of the Youghiogheny River and Jacobs Creek through Brush Ridge, which corresponds approximately to the Fayette anticline.

BROOKVILLE (A)-CLARION (A') COAL

This coal has a persistent occurrence along its line of outcrop and is generally of mineable thickness. The Brookville and Clarion coals are generally considered as two separate beds, but in Fayette County they are usually separated by only a short interval of intervening strata and sufficient information to differentiate the two beds is commonly lacking. The interval between the two beds averages approximately 6 feet along the outcrop and in many places it apparently is only several inches of shale or clay. Hence, in this report, the two beds are considered as a unit, termed the Brookville-Clarion coal. West of Chestnut Ridge in the gorge of Youghiogheny River and Jacobs Creek, through Brush Ridge, this coal ranges in thickness from 3 to 17 inches and consists of fairly clean coal. Along the west and east slopes of Chestnut Ridge, from the north county boundary southward to within two miles of the National Pike, the Brookville-Clarion coal reaches mineable proportions only in local areas, in which it may be 40 inches thick. The lower part frequently consists of bony or dirty coal and is separated from an upper bench of fairly clean coal by a persistent binder of shale or bone. South of the National Pike along the ridge in North and South Union, Georges, and Wharton townships, the coal is usually triple benched and attains thicknesses of 8 to 9 feet. The top and bottom benches are composed frequently of dirty or bony coal with numerous balls or lenses of pyrite. The middle bench contains fairly clean coal. Shale or clay partings up to 12 inches thick separate the benches.

In the Ligonier Valley the Brookville-Clarion coal is above drainage in the area north of Ohiopyle. It is generally mineable and contains fairly clean coal, although its thickness becomes variable and decreases slightly toward the north. Along the west slopes of Laurel Hill, the coal exhibits the same characteristics as in the Ligonier Valley. In Henry Clay Township, just south of the National Pike, the coal is split into three benches separated by thin clay or shale partings and has the same characteristics and exceptional thicknesses as along Chestnut Ridge in South Union and Wharton townships.

LOWER KITTANNING (B) COAL

The Lower Kittanning coal has a regular and persistent mineable occurrence along its outcrop in Fayette County. It is between 18 and 60 inches thick and consists generally of clean coal except for a layer of bone or bony coal from 0 to 12 inches thick at the top of the bed. In the northwest corner of the county, diamond drill holes near Bellevernon show the bed to have an average thickness of about 42 inches. In the gorges of Youghiogheny River and Jacobs Creek, through Brush Ridge (Fayette anticline), the coal is 24 to 40 inches thick and is free from persistent partings. Lenses or balls of pyrite are found infrequently near the base of the bed. The bone coal at the top of the bed is up to 3 inches thick and is commonly missing. Along the slopes of Chestnut Ridge, the Lower Kittanning coal is between 18 and 54 inches thick and averages about 36 inches. A layer of bone coal at the top of the bed has an average thickness of about 4 inches. In some localities this top layer is sufficiently clean to be mined. The coal is mineable throughout the length of the Ligonier Valley, in which it has an average thickness of about 36 inches. The top 4 to 12 inches is usually bone or bony coal, but locally clean enough to mine. In the vicinity of Indian Head, Saltlick Township, the bed has an average thickness of 46 inches and contains, besides the top layer of bone, a non-persistent bony binder just above the middle of the bed. The thickness decreases slightly to the south and an average for the central and southern parts of the valley would probably be about 36 inches. Along Laurel Hill and in the southeast corner of the county the thickness ranges from 18 to 55 inches and the coal generally is clean in all except the top 0 to 12 inches, which are bone or dirty coal. Locally, one or more thin partings of shale may be present in the basal 10 inches of the bed.

The top few inches of the Lower Kittanning bed in Fayette County ranges from a cannel shale through bone and bony coal to a coal of fair purity. Generally it is bone that is high in ash and sulphur and must be separated from the good coal. During mining operations, the top bony layer tends to separate easily from the overlying shale and must be hand sorted in the mine and possibly on the surface. The gray to dark shale that normally overlies the coal forms a satisfactory and durable roof. Locally, sandstone lies directly on the coal and it also makes a good roof.

The normal floor of the Lower Kittanning coal is a gray plastic clay that locally may be separated from the coal by several inches of shale. The under clay is from 3 to 10 or more feet thick and has been found suitable for the manufacture of refractory and face brick. Hence, where the clay is mined, the customary practice is to mine the coal also from the same opening.

The Lower Kittanning coal has been developed commercially in the valley of Indian Creek in Springfield and Saltlick townships. Here the disposal of the mine water, as required by law, presents an unusual problem. The operating companies are not permitted to discharge the drainage from the mines into Indian Creek above the reservoir south of Normalville. To surmount this difficulty, a mutual company was formed to construct and maintain a main and branch flumes in which the drainage from the various mines would collect and empty into Indian Creek below the reservoir. The flumes are partly on the surface, partly through abandoned mine workings, and partly through a tunnel that was driven for this purpose. The operation has proven satisfactory, although it undoubtedly adds to the mining costs.

MIDDLE KITTANNING (C) COAL

The Middle Kittanning coal was observed to attain mineable thickness only in the gorges of Jacobs Creek and Youghiogheny River through Brush Ridge (Fayette anticline). It cannot be considered a resource, as it changes rapidly between 0 and 30 inches in thickness and is composed of bony or dirty coal. Elsewhere in the county, along its line of outcrop, the Middle Kittanning coal is less than 12 inches thick and is frequently missing from the section.

UPPER KITTANNING (C′) COAL

The Upper Kittanning coal has a fairly persistent occurrence in Fayette County where the Allegheny formation has its normal thickness. Along the slopes of Chestnut Ridge and Laurel Hill, where the formation is thin, the coal commonly is absent. In other parts of the county the coal lies about 90 feet below the top of the formation. It has mineable proportions in the gorges of Jacobs Creek and Youghiogheny River through Brush Ridge, where the bed is from 20 to 32 inches thick and consists of rather dirty coal with a 1- to 4-inch layer of bone at the top. In the Ligonier Valley the Upper Kittanning coal is locally of mineable thickness. It ranges from 12 to 108 inches in thickness and is composed of two or three benches that are separated by from 3 to 6 inches of shale or clay. The lower half of the bed is frequently bony and the upper half is somewhat dirty in the northern part of the Ligonier Valley. In the Turkeyfoot and the southern part of the Ligonier valleys, the bed is thick enough to mine and contains coal of fair quality, although thin lenses of shale and pyrite are common near the base.

The only known occurrence of cannel coal in Fayette County is about ¼ mile east of Mill Run in Springfield Township. Here a small custom bank is working a 20- to 40-inch bed of cannel coal that is correlated with the Upper Kittanning horizon.

LOWER FREEPORT (D) COAL

The Lower Freeport coal lies at an average interval of about 50 feet below the Upper Freeport coal and has a fairly persistent occurrence in Fayette County. However, it varies greatly in thickness and has mineable proportions only in some parts of the county. The coal is reported in drill holes near Bellevernon and in Luzerne Township to be from 12 to 26 inches thick. In the gorges of Jacobs Creek and Youghiogheny River through Brush Ridge in Lower Tyrone, Perry and Franklin townships, the Lower Freeport coal is less than 15 inches thick. The meager data indicate that the bed is thin in the western part of the county.

On the west slopes of Chestnut Ridge the Lower Freeport coal is mineable locally in Bullskin, Connellsville, and northern Dunbar townships. East of Dunbar the bed is from 24 to 48 inches thick and contains fairly clean coal throughout, except for a 2- to 3-inch binder of bone near the top. In this locality it was mined commercially in the past. Southward along the ridge to the State boundary this coal is less than 15 inches thick.

In the Ligonier Valley the bed is well developed in central Springfield and southern Saltlick townships, where it is from 40 to 96 inches thick. The upper half of the bed contains fairly clean coal, but the lower half shows from two to five partings of shale or clay, each of which may be from ¼ to 2 inches thick. Commercial mines have operated on this coal along Indian Creek in central Springfield Township. Throughout the remainder of Ligonier Valley, the Lower Freeport is from 6 to 48 inches thick. The greater thicknesses are exceptional and generally the bed is less than 18 inches thick. In southeast Wharton Township an exposure showing about 40 inches of clean coal is tentatively correlated with the Lower Freeport horizon. In the Turkeyfoot Valley the coal was not observed to be mineable in any outcrop.

UPPER FREEPORT (E) COAL

The Upper Freeport has a persistent occurrence in Fayette County. In normal habit it is from 2 to 9 feet thick and contains one or more persistent partings of shale or clay. Unusual thicknesses of only several inches or as much as 16 feet were observed. Where thickest, the bed contains a greater number of sizable partings.

In the western part of the county along the Monongahela River, records of the few available diamond drill holes show thicknesses between 3 and 6 feet. These reports and the information obtained from the logs of gas wells indicate a general mineable thickness for this bed in the western part of the county, where the Upper Freeport coal lies at depth. In the gorges of Jacobs Creek and Youghiogheny River through Brush Ridge in Perry, Franklin and Lower Tyrone townships, the Upper Freeport coal lies above drainage and is of workable proportions. It is split into two benches by a persistent clay parting from 1 to 12 inches thick that lies near the base of the bed. The total thickness of the coal ranges from 30 to 70 inches. It has been mined commercially in the past. Locally the bed is missing from the section, as in the clay mine just west of Layton, where the overlying Mahoning sandstone has entirely replaced the coal.

On the west slopes of Chestnut Ridge, in Bullskin, Connellsville, Dunbar, and North Union townships, the Upper Freeport coal is from 3 to 8 feet thick, with an average of about 54 inches. It contains two persistent partings, one of clay near the base and one of bone or shale near the middle. The coal is of good quality except for a layer of bone from 1 to 10 inches thick at the top of the bed. This top part and the thin basal bench frequently contain numerous lenses of pyrite. Commercial mines have operated in Bullskin and Connellsville townships and at several of these the underlying Upper Freeport and Bolivar clays were mined in conjunction with the coal. East of Dunbar, the Upper Freeport coal was mined extensively. The coal was cleaned by washing and was coked in a battery of by-product coke ovens near the mines. This operation was abandoned in the early 1920s and the by-product ovens were dismantled.

South of the National Pike, along the west slopes of Chestnut Ridge, the thickness of the Upper Freeport coal increases to an average of about 7 feet. It contains three persistent partings of shale, each of which is up to 12 inches thick, and frequently shows several non-persistent, thin clay partings. The upper half of the bed is rather dirty coal with numerous "knife-edges" of shale, but the lower half generally contains coal of good quality. Lenses and balls of pyrite may occur near the base of the bed. In northern Springhill Township an exceptional thickness of 16 feet was reported for this bed.

In the Ligonier Valley, the Upper Freeport coal ranges between 1 and 9 feet in thickness and is usually mineable. It averages about 36 inches in Saltlick and Springfield townships, where it is termed the "block-slate" coal. The name is derived from the persistent parting of shale or bone coal that occurs near the middle of the bed. In these townships the coal is fairly clean. It was opened on a commercial basis during the World War period and in the coal boom of 1920-21. Farther south in the Ligonier Valley, in Stewart and Wharton townships, the average thickness of the Upper Freeport coal increases slightly and reaches its maximum of about 54 inches in southwest and central Wharton Township. Through this area it contains a persistent clay parting near the base of the bed and several non-persistent partings of clay or shale that may attain thicknesses of 6 inches. The coal is generally clean and a product of good quality may be obtained by careful mining. Commercial mines were formerly operated on this coal near Ohiople.

In the Turkeyfoot Valley in Henry Clay Township, the Upper Freeport coal averages about 54 inches thick. It is divided into two benches by a persistent clay parting near or just below the middle of the bed. Several non-persistent partings of clay, shale, or bone are scattered through the bed. Lenses and balls of pyrite are rather common near the base of the bed. Commercial mines operated near Somerfield during the World War and for several years thereafter.

In normal occurrence the Upper Freeport coal in Fayette County is separated from the overlying Mahoning sandstone by 2 to 20 feet of shale or clay shale. Locally, the Mahoning sandstone may cut or roll down and replace the intervening shale and some or all of coal bed to create a condition known locally as "faults." These "faults" generally affect only small areas. In the region west of the crest of Chestnut Ridge, a gray clay shale forms the normal roof of the coal bed. This shale tends to soften and slack on exposure to air and creates considerable trouble in mining. Similar conditions exist locally in the Ligonier and Turkeyfoot valleys, but generally the roof is not troublesome in these areas. Clay veins are reported occasionally to cut through the Upper Freeport bed in all sections of the county. They occur more frequently in the areas where the overlying shale is plastic. The floor of the coal is a gray plastic clay which softens after exposure to the atmosphere. In many operations the basal bench of the coal, which is usually thin, is left in place to provide a hard, satisfactory floor.

Conemaugh Coals

Coal beds of the Conemaugh formation occur throughout the Turkeyfoot and Ligonier valleys, along the lower slopes of Laurel Hill and Chestnut Ridge, along Brush Ridge or the Fayette anticline, and along many of the streams of western Fayette County. Only a few of them appear to be persistent and the rest occur sporadically as thin lenses. Although several of them attain mineable proportions locally, they have no value at present or in the immediate future as coal resources. The following beds of this formation have been worked for local custom coal.

MAHONING COAL

The Mahoning coal lies at an average interval of 60 feet above the base of the formation. It was observed to be mineable locally west of Chestnut Ridge in Bullskin Township and through the Ligonier and Turkeyfoot valleys. In northern Bullskin Township this bed is from 20 to 28 inches thick. It has a layer of bone coal from 1 to 7 inches thick at the top and the remainder of the bed appears to be high in sulphur as judged from a white sulphate coating on exposed surfaces. In northern Saltlick Township the bed is composed of two or three coal benches separated by shale and clay partings up to 10 inches thick. The total thickness is between 18 and 48 inches. In the rest of the Ligonier Valley and in the Turkeyfoot Valley, the coal is from 6 to 36 inches thick, with a clay parting just above the middle of the bed. The top is usually a bony or dirty coal. Unusual thickness of the bed was observed in the southeast corner of Wharton Township, where it is from 36 to 66 inches thick. However, the bed contains a thick clay parting near the middle, and the top 2 to 12 inches of the upper bench is bony coal.

BRUSH CREEK COAL

The Brush Creek coal is developed best in the southern parts of Ligonier and Turkeyfoot valleys, where it is from 12 to 30 inches thick and contains fairly clean coal. Throughout the remaining areas of outcrop in the county, the bed is persistent, but is less than 20 inches thick.

LOWER BAKERSTOWN COAL

The Lower Bakerstown coal lies about 180 feet above the base of the formation and is generally present in the area of outcrop. It is mineable along the crest of Fayette anticline in Lower Tyrone, Perry, and Franklin townships, where the thickness ranges between 10 and 33 inches. A thin layer of bone is commonly present at the top of the bed. It is mineable very locally in Stewart and eastern Henry Clay townships. Here it is as much as 36 inches thick at places and has a persistent bone binder near the middle. In central Wharton Township, this coal is from 18 to 40 inches thick and contains a bone layer 1 to 10 inches thick at the top. It is mined in this area for local use in conjunction with the closely underlying Cambridge limestone. In the vicinity of Farmington, the local name ''Hagar coal'' has been applied to this bed. Observations in other sections of the county showed the bed to be less than 18 inches thick.

BAKERSTOWN COAL

The Bakerstown coal is from 20 to 36 inches thick along its line of outcrop on the Fayette anticline near the Youghiogheny River. Along Redstone Creek in Menallen and North Union townships, the bed is from 30 to 36 inches thick and appears to consist of clean coal. North of Ohiopyle in the Ligonier Valley the coal locally becomes as much as 45 inches thick. However, it contains several shale and clay partings and is composed of dirty coal.

OTHER COALS

The only other coal beds of the Conemaugh formation that become mineable locally are the Harlem and Barton coals. The Harlem bed was observed to be up to 20 inches thick in eastern Menallen Township and about 24 inches thick in southeastern Henry Clay Township. In both localities the coal is dirty. The Barton coal is from 15 to 40 inches thick in central and southern Franklin Township along its outcrop on the Fayette anticline. The bed contains several clay or shale partings and the coal is dirty.

Monongahela Coals

Coal beds of the Monongahela formation occur only in the western part of Fayette County, where they crop out in two general areas, the Uniontown-Connellsville basin and the Klondike or River district. In the southwest county corner, these two areas are connected by patches of the Monongahela formation that extend over the intervening Fayette anticline in the hilltops. This formation contains the most important commercial coals of the county. The remarkable Pittsburgh coal at the base of the formation has been mined extensively for a long time and is by far the more important bed. It is followed in importance by the Sewickley and Waynesburg coals, both of which have been exploited more or less extensively. The Redstone and Uniontown beds are of minor importance only, and the Pittsburgh Rider and Little Waynesburg coals are not of any value.

PITTSBURGH COAL

The Pittsburgh coal bed at the base of the Monongahela formation is persistently present throughout Fayette County as a thick bed of mineable proportions. The lower bench below the ''draw-slate'' contains coal of excellent commercial quality and is the only part of the bed that is mined. The coal occurs in two general areas in the western part of the county, the Uniontown-Connellsville basin just west of Chestnut Ridge and the Klondike or River district. The two areas are separated by Brush Ridge (Fayette anticline), from which the Pittsburgh coal has been removed by erosion in all except the southwestern part of the county. As defined by the outcrop of the Pittsburgh coal, the Uniontown-Connellsville coal basin proper is rather long and narrow, being 25 miles long and 5½ miles wide at its greatest width. It extends from Jacobs Creek in Bullskin Township to Smithfield in southern Georges Township. The deepest point is in northern North

Union Township, one mile northwest of Bethelboro, at which point the Pittsburgh coal is 500 to 520 feet above sea level. The coal rises in all directions from here, gently parallel to the synclinal axis and steeply up the limbs of the syncline. In Bullskin Township, at Jacobs Creek, the coal has an altitude of 1,080 feet and at Smithfield, 1,100 feet. The eastern limb of the syncline is very steep, the coal rising at a maximum rate of 800 feet to the mile. The western limb is all more gentle, with the maximum rise of the coal at 450 feet to the mile.

Between Smithfield in Georges Township and Outcrop in northern Springhill Township, a "high" on the synclinal axis places the Pittsburgh coal in the hilltops only so that the altitude of the coal is from 1,100 to 1,120 feet. South from Outcrop, the axis descends slightly, the low point occurring ½ mile north of Lake Lynn Station, where the coal is 1,035 feet above sea level. From this low point the coal rises eastward to the outcrop at 1,200 feet altitude, westward to 1,145 feet, and to the south, where the axis crosses the State line, the coal has an elevation of 1,060 feet.

The Lower Connellsville River or Klondike district includes the part of the county that lies between the Monongahela River on the west and the outcrop of the Pittsburgh coal on the eastern limb of the Lambert syncline. This crop line has a general northeast-southwest trend and extends from the point where the Youghiogheny River leaves the county at Jacobs Creek, southwestward through Smock and Footedale to New Geneva, at which point it leaves the county.

The structures of the Klondike district are the Lambert syncline, Brownsville anticline, Port Royal syncline, and the eastern limb of the Bellevernon anticline, all of which have the general northeast-southwest structural trend of the region. The most pronounced structure is the Lambert syncline, which has a relatively steeply inclined eastern limb, a wide rather flat bottom, and a gently sloping western limb. At the deepest point on this syncline, 1½ miles east of Republic, the Pittsburgh coal is 400 feet above sea level. Along the synclinal axis, to the south, the coal rises to 550 feet at Gates, and to the north the coal attains an altitude of 780 feet just northeast of Redstone, at which point the Lambert syncline joins the Port Royal syncline.

The Brownsville anticline enters the county from the south at East Riverside in southern Luzerne Township and extends through Brownsville to Little Redstone School in southern Washington Township, where it ends. The structure is more pronounced towards the south, although its high points occur where the axis of the fold crosses Redstone Creek, and in the vicinity of Little Redstone School. At these localities, the Pittsburgh coal has an elevation of 800 feet. Southward from Brownsville, the axis plunges until at East Riverside the Pittsburgh coal is 640 feet above sea level.

The Port Royal syncline enters the county from the north approximately 1 mile northwest of Wickhaven. The Pittsburgh coal here has 680 feet elevation and rises 100 feet as the synclinal axis is followed to Gillespie. Southward along the axis, the elevation of the coal falls to 720 feet at a point two miles north of Brownsville, where the axis leaves the county. It reenters Fayette County 1½ miles west of

Brownsville with the Pittsburgh coal at 700 feet and plunges southward to Arensburg, where the coal is 630 feet above sea level. This syncline is not well developed through Fayette County except in Washington Township, where it plunges to the northeast and is joined by the Lambert syncline.

The eastern limb of the Bellevernon anticline is present only in the vicinity of Bellevernon, where the Pittsburgh coal is 880 feet above sea level, and in the vicinity of Maxwell in western Luzerne Township, where the Pittsburgh coal has an elevation of 800 feet. In both places the slope of the coal is gentle, averaging 55 feet to the mile. The axis of this anticline is 1 mile northwest of Bellevernon and 1½ miles northwest of Maxwell.

In the Brush Ridge or Fayette anticline district the Pittsburgh coal has been eroded from the northern part and it is not present until one mile south of the National Pike in southern Menallen Township. At this point, the Pittsburgh coal is at an elevation of 1,320 feet, and it plunges rapidly to the northwest and southeast into the Klondike and Uniontown-Connellsville districts respectively. South from the pike, the Pittsburgh coal is present in more and more hilltops as the Fayette anticline plunges in that direction. At Point Marion, the Pittsburgh coal is 1,140 feet above sea level on the axis of the Fayette anticline. All of the Pittsburgh coal in the Brush Ridge district is in the hilltops, and in some places not all the coal is preserved.

The character and physical makeup of the Pittsburgh coal are remarkably regular and persistent all through the county. The bed is typically double-benched and the divisions have been named the roof coal or upper division, the main clay parting or overclay, and the lower or main division. These members are commonly present and have a total thickness between 10 and 20 feet.

The upper division, or roof coal, has a persistent occurrence in the Uniontown-Connellsville basin, although it may be cut out very locally and replaced by the overlying Pittsburgh sandstone. It is generally between 3 and 10 feet thick and consists of dirty coal that has no commercial value. The bed is composed of numerous layers of coal or bone up to 24 inches thick which are separated by thin beds of black shale up to 18 inches thick. As a rule, the coal and black shale are interstratified inseparably in bands under 12 inches thick. The total thickness increases slightly southward to the State boundary.

In the Klondike district the roof coal is generally present in all except the area where the Lambert syncline attains its greatest structural depth. Here, in eastern Luzerne, northern German, and central Redstone townships the roof coal is lacking over large areas. Close outside the boundaries of this area, the roof division consists usually of a single bed of bony coal from 2 to 18 inches thick and farther from the area it resumes the normal character which persists over the remainder of the Klondike district. In normal occurrences, the roof division is from 3 to 10 feet thick and contains valueless coal. It has the same physical composition as in the Uniontown-Connellsville basin and thickens to the south.

The main clay parting or overclay of the Pittsburgh coal bed is the so-called "draw slate" of Fayette County. It is generally persistent and is between 2 and 24 inches thick. Locally, it may be replaced by the overlying Pittsburgh sandstone, and in southern Springhill Township it appears to be missing over sizable areas in which the roof coal rests directly on the lower division. In the latter area the "draw slate" had not been deposited. The main clay parting is troublesome when mining the lower division because it tends to fall away from the roof coal division and to cling or is "burned" to the top of the underlying coal.

The lower or main division contains the commercial coal of the Pittsburgh bed. It usually ranges between 72 and 120 inches thick in Fayette County, but exceptional thicknesses considerably below and above these limits have been reported in very local instances. It is regular and persistent in occurrence and contains remarkably clean coal. Generally, the lower division attains its greatest thickness in the Uniontown-Connellsville basin north of Uniontown. In this basin south of Uniontown it is slightly thinner, and in the Klondike district the average thickness shows a further slight decrease. The smallest average thickness is found in the northwest corner of the county. The lower division is subdivided into several benches known from top to bottom as the breast coal, bearing-in coal and bottom coal. The brick and lower bottom coals of other counties are recognizable only in the northwest corner of the county. Elsewhere they cannot be separated because the brick coal does not show its characteristic blocky nature and the thin shale parting that separates them is commonly lacking in Fayette County.

The breast coal at the top of the lower division ranges between 36 and 80 inches in thickness and is generally free from persistent partings. In the northern halves of the Uniontown-Connellsville basin and the Klondike district, a thin non-persistent shale binder generally less than ½ inch thick is frequently found near the center of the breast coal. It is called the "penny slate." The coal in this bench usually is clean and tender and tends to break into small cubes. However, in the southwest part of the county in Luzerne, Redstone, German, Nicholson and western Springhill townships the top 4 to 10 inches of the breast coal is made dirty by fairly numerous shale and pyrite streaks or "knife-edges" up to ¼ inch thick. Hence, in this area, the top 4 to 8 inches of the coal is commonly left in place during first mining to serve the double purpose of supporting the overlying "draw slate" and to preserve the high quality of the underlying coal. The top layer is usually recovered in second mining and is suitable for use as steam or gas coal. It is general practice, wherever the overlying "draw slate" is troublesome, to leave the top 6 to 12 inches of the breast coal in place to support the roof and to recover this coal in the second mining.

The bearing-in coal underlying the breast bench is easily recognizable through the county. It consists of a layer of coal from 2 to 7 inches thick bounded on the top and bottom by persistent shale binders that average less than ½ inch thick. Locally, either one of the binders may be absent. At some places the entire bearing-in bench is reported to consist of bone coal, but this condition is exceptional. In mining, the two binders tend to cling to the adjacent coal and are difficult to separate. Usually the only separation attempted is by hand-sorting in the mine.

The bottom coal is from 24 to 46 inches thick and generally contains clean coal free from persistent binders. The upper part of this bench usually has a blocky character and is slightly harder than the lower part. In the northwest corner of the county this difference is marked and the two parts are generally separated by a thin shale parting. These parts correspond to the brick and lower bottom coals of other regions and are respectively 14 and 16 inches thick in this part of Fayette County. Elsewhere in the county they are not separable and the dividing shale parting is commonly lacking. Hence they are grouped together and called the bottom coal. In the southern part of the Klondike district, the basal 2 to 10 inches of the bottom coal contains numerous thin lenses of shale and pyrite and is classed more properly as bony coal. Frequently from 4 to 8 inches at the base of the bed is left in place during the first mining. This may or may not be recovered, depending on the purity and the evenness of the coal and underclay contact.

The lower division in southern and southwestern Springhill Township is an exception to the foregoing descriptions of this part of the Pittsburgh bed. Here the lower division is not divisible into the three general coal benches. It is between 75 and 105 inches thick, of which the top 12 to 18 inches is commonly called bone coal. Generally the upper half of the lower division contains coal of rather low quality and has from 5 to 15 partings of bone, clay, or shale up to 3 inches thick. The lower half consists of clean coal that is free of persistent binders. Most of the partings tend to separate from the coal and can be removed on picking tables or belts at the surface so that a clean product can easily be obtained. Much of the coal mined in this area is used for steam coal. The so-called ''sandstone faults'' or filled erosion channels that are described in the discussion on Nicholson and Springfield townships occur in the area and present unusual difficulties in mining the coal. They range from a few feet up to about 800 feet in width. Single ''faults'' of similar character but less than 10 feet in width are reported to occur in Nicholson, German, Luzerne, Georges and Dunbar townships.

In Fayette County the floor of the Pittsburgh bed is generally free of any marked irregularities, but it is reported to have minor rolls or ''horse-backs'' at places. It consists usually of gray plastic clay which may contain nodules of limestone or iron carbonate. Locally it is troublesome during mining operations, as it tends to soften and squeeze after exposure to air. In such cases the basal 6 to 12 inches of the lower division is left in place during first mining and recovered later.

REDSTONE COAL

The Redstone coal has an irregular occurrence in the western part of the county, where it lies from 50 to 95 feet above the base of the formation. In the Klondike district it was observed to be mineable locally in Jefferson, Washington, Perry, western Franklin, southern

German, Nicholson and Springhill townships. North of Little Redstone Creek in Jefferson and Washington townships the bed averages about 42 inches thick and contains clean coal throughout, with the exception of a 4-inch bone binder near the middle. In Perry and western Franklin townships the coal is 36 to 48 inches thick and is free from partings. The top 2 to 6 inches is bone coal. The coal in the southwestern part of the county is 27 to 36 inches thick and is split into two benches by a persistent parting of shale or bone 1 to 7 inches thick. The lower bench is locally a bony, hard coal.

In the Uniontown-Connellsville basin the Redstone coal is persistent and generally mineable on the east limb of the syncline. Through Connellsville, Dunbar, and North and South Union townships the bed is from 20 to 48 inches thick and appears to be composed of coal of fair quality. In Georges Township the average thickness is about 26 inches, of which the lower part is usually bony coal. Along the west limb of the syncline the coal is thin and is absent over large areas. The Redstone coal has been opened at numerous localities in the above area to obtain coal for local use. Its roof and floor are generally gray plastic clay or shale that tends to soften and slack after exposure to air. Clay veins of varying thickness commonly cut through the bed in all localities where the coal has been mined.

SEWICKLEY COAL

The Sewickley coal has a persistent occurrence throughout Fayette County. It is an important commercial coal in the southwest quarter of the county, where it is known locally as the ''5-foot'' bed. In this area, through southern German, Nicholson, Springhill, Georges, and North and South Union townships, the coal is from 30 to 78 inches thick and averages approximately 60 inches thick over most of the area. The bed is commonly split into two benches by a parting of shale or bone near the middle. This parting is from 1 to 24 inches thick and averages about 5 inches. The top 2 to 6 inches of the bed is generally bone coal. Thin lenses or ''knife-edges'' of shale and pyrite are fairly common throughout the bed. Because of their inseparability from the coal, the ash and sulphur contents are rather high. Commercial mines have developed this coal extensively in North and South Union, Georges, Nicholson, and southern German townships. In the northwest part of the county the Sewickley coal is between 18 and 48 inches thick. It is generally dirty with thin shale or clay partings and contains two or more fairly persistent partings of bone or shale. In Perry Township the coal has been opened near Perryopolis, where it is from 24 to 48 inches thick and contains layers of bone coal from 1 to 8 inches thick at the top, near the middle, and at the bottom of the bed.

North of the National Pike in the Uniontown-Connellsville basin, the Sewickley coal bed is split into three benches that are termed the Lower, Middle, and Upper Sewickley coals. They are separated by an appreciable interval which may be as great as 35 feet between the lower and upper splits. The Lower Sewickley coal is the more persistent of the three benches. It has been mined commercially along the eastern outcrop as far north as the Youghiogheny River. In

Connellsville and Dunbar townships it is 30 to 50 inches thick and is separated into three sections of about the same thickness by two thin partings of clay. The Middle Sewickley has a sporadic occurrence and rarely has mineable thickness. The upper split is fairly persistent and is from 18 to 48 inches thick. The upper half of this split is usually dirty or bony coal and the lower half generally contains clean coal.

In Fayette County the normal roof of the Sewickley coal is gray to dark clay shale or shale. In some localities the overlying Sewickley sandstone rolls down and rests directly on the coal. Clay veins that cut through the bed are reported to be of infrequent occurrence.

UNIONTOWN COAL

The Uniontown coal attains mineable thickness and quality only in small local areas in the western part of the county. In Jefferson and Washington townships it is from 18 to 48 inches thick and is composed of dirty coal with three or more clay partings. North of Allison in Redstone Township the bed is 50 inches thick in a small area. It contains numerous shale and clay partings that constitute an appreciable part of the total thickness. Elsewhere in the Klondike district the coal is less than 24 inches thick and consists of dirty or bony coal with several partings.

The Uniontown coal was observed to be mineable at only one locality in the Uniontown-Connellsville basin. In Dunbar Township, two miles south of Vanderbilt, the bed is 40 to 48 inches thick, but is composed of rather dirty coal, with two or three shale partings in the lower half. A mineable thickness is reported in the Leith shaft in South Union Township, but this occurrence is evidently limited to a small area around the shaft. Elsewhere in this basin the coal is thin and is frequently missing over sizable areas.

WAYNESBURG COAL

The Waynesburg coal is at the top of the Monongahela formation, and has a persistent occurrence through the western part of Fayette County. It usually is of mineable proportions and is the youngest (highest) coal of commercial value in the county.

In the Klondike district the coal was mined rather extensively in Redstone, Luzerne, Menallen and German townships during the World War period and for several years thereafter. Through these townships it is a triple-benched bed separated by clay partings of sizable proportions. The top bench, from 2 to 20 inches thick, is generally a bone coal and usually is not mined. It is separated from the middle bench by a clay parting from 1 to 12 inches thick. The middle bench is from 12 to 36 inches thick and consists of fairly clean coal, with the exception of a 2-to-6-inch layer of bone coal at the top. A clay parting with an average thickness of 10 to 15 inches separates the middle and lower coal benches. The lower bench is from 12 to 42 inches thick and contains hard, somewhat dirty, coal. Thin lenses of shale and pyrite are frequently found near the base of the bed. In Jefferson and Washington townships the coal bed is mineable in the area between Redstone and Little Redstone Creeks. Here it is from

24 to 72 inches thick and contains one to three clay partings, each of which ranges up to 24 inches thick.

In the Uniontown-Connellsville basin the coal is present persistently as a double-benched bed from 24 to 54 inches thick. It crops out through Dunbar, North and South Union, and north-central Georges townships, near the axis of the basin. The coal of both benches shows some thin lenses of shale and has a rather dirty appearance. Balls of pyrite have a scattered occurrence. A shale or clay parting from 2 to 18 inches thick occurs just below the middle of the bed and is persistent in the area. The coal has been opened at several places near Uniontown and in northern Dunbar Township to supply custom coal.

This bed in the Uniontown-Connellsville basin was correlated as the Uniontown coal by the geologists of the First and Second Geological Surveys of Pennsylvania. Data obtained through the extensive mining of the Pittsburgh coal in this area indicate that the bed is correlated more properly with the Waynesburg horizon. Details of this latter correlation are given in the general discussion on stratigraphy in this report.

Permian Coals

The Permian coal beds occur in two relatively small areas in the western part of Fayette County. In the Uniontown-Connellsville basin they occur in a rather narrow belt along the synclinal axis extending from the Youghiogheny River through Dunbar and North and South Union townships into north-central Georges Township. These coals in the River or Klondike district crop out roughly to the west of a line through Perryopolis, New Salem, and Masontown. In this area north of Redstone Creek and in Luzerne Township they are found only in the high hilltops, but elsewhere in the area along the axis of the Lambert synclinal the lower coals of this age are below drainage.

The Permian coals in the Uniontown-Connellsville basin are thin and appear to be of irregular occurrence. They were not observed to be thicker than 20 inches at any place and are composed of dirty or bony coal. In the Klondike district several of the coals are persistent and locally may attain mineable proportions. They contain dirty or bone coal and are generally split by numerous shale or clay partings. None of the Permian beds in Fayette County contain coal of commercial quality.

WAYNESBURG (A) COAL

A coal that lies about 65 feet above the base of the formation and is known as the Waynesburg A, has a persistent occurrence in the Klondike district. It varies greatly in thickness and contains coal of poor quality. In Jefferson, Washington, Brownsville and Redstone townships the bed is from 3 to 60 inches thick and commonly exhibits three or more clay or shale partings. It has been opened in southeastern Redstone Township, where it is 37 to 39 inches thick and contains several shale partings. Streaks of shale and pyrite are scattered throughout the bed. In Luzerne Township the bed is usually a bone coal from 20 to 40 inches thick. Through its area of occurrence in

German and Menallen townships the Waynesburg A coal is from 28 to 56 inches thick and shows several clay or shale partings, of which some are 7 inches thick.

WASHINGTON COAL

The Washington coal, lying about 160 feet above the Waynesburg coal, occurs persistently throughout its area of outcrop as a thick bed of dirty coal. In Jefferson Township it is from 8 to 10 feet thick. Five major partings of black shale, and numerous thin shale or clay partings, are commonly present. The contained coal is low grade. Through Redstone Township the coal is 18 to 48 inches thick and is divided into three benches by two major partings of clay. The coal is dirty with numerous thin partings and streaks of shale. In the remaining area of its occurrence in the Klondike district the Washington bed is less than 24 inches thick and is composed of dirty coal.

OTHER COALS

The only other coals of the Permian formation that were observed to attain local mineable thickness are the Waynesburg B and Little Washington beds. Both of these beds reach thicknesses of 30 to 36 inches at some localities in Redstone Township. They are composed of dirty to bone coal and contain several shale partings.

COAL AND COKE ANALYSES

Rank of Fayette County coals

The tentatively adopted classification of coals of the American Standards Association would place the coals of Fayette County in two ranks. West of Chestnut Ridge, the coals are of high-volatile A bituminous coal rank as the fixed carbon content of these coals on a dry, mineral-matter-free basis is less than 69%, and the moist, mineral-matter-free B.t.u. content is more than 14,000. East of Chestnut Ridge the coals are of medium-volatile bituminous coal rank, as the dry, mineral-matter-free fixed carbon content of these coals is more than 69% and less than 78%. The stratigraphically higher coals, east of Chestnut Ridge are just above the division line between the medium-volatile and high-volatile A bituminous coal ranks and in some exceptional cases these coals fall in the high-volatile A rank. However, the coals below the Upper Freeport, east of Chestnut Ridge, are well within the limits of the medium-volatile rank.

The following set of calculated dry, mineral-matter-free fixed carbon and moist, mineral-matter-free B.t.u. contents for the various coals of Fayette County are arranged according to major structures from west to east. The figures show the increase in fixed carbon content from stratigraphically higher to lower coals and also from the region of gentle folding in the west to the more severe folding in the east. The results were calculated from the analyses (United States Bureau of Mines) of a mine that represents an average for the specified coal in the major structure listed.

Rank of coals with relation to structure

Structure	Mine	Bed	Dry, mineral-matter-free fixed carbon	Moist, mineral-matter-free B. t. u.
Port Royal syncline	Hustead	Pittsburgh	60.6	15,015
Lambert syncline	Patrick No. 1	Sewickley	54.9	14,690
Lambert syncline	Griffin No. 1	Pittsburgh	63.4	14,890
Fayette anticline	Jacobs Creek Oil Co.	Upper Freeport	63.3	15,012
Fayette anticline	Corrado No. 2	Lower Kittanning	64.7	15,118
Uniontown syncline	Meadowbrook	Sewickley	61.8	14,893
Uniontown syncline	Leisenring No. 1	Pittsburgh	63.9	15,063
West flank—Chestnut Ridge	Furnace No. 2	Upper Freeport	64.1	15,022
West flank—Chestnut Ridge	United Refractories	Lower Kittanning	66.1	15,009
Ligonier syncline	May bank	Upper Freeport	69.3	14,801
Ligonier syncline	Torrence	Lower Kittanning	71.9	15,109
Johnstown syncline	Thomasdale	Upper Freeport	70.7	15,226

The fixed carbon and B.t.u. values in the table were calculated by the following formulas.* Mineral matter was taken as 1.1 times the ash.

$$\text{Moist fixed carbon} \times \frac{100}{100 - (\text{moisture} + 1.1\ \text{ash})} = \text{dry, mineral-matter-free fixed carbon.}$$

$$\text{Moist B.t.u.} \times \frac{100}{100 - 1.1\ \text{ash}} = \text{moist, mineral-matter-free B.t.u.}$$

Coal Analyses

The analyses of Fayette County coals are presented in a set of four tables arranged according to the analysts and the material available. Miscellaneous tables given after the four major tables of analyses present the results of steam, washing and coking tests on various Fayette County coals. Several analyses from mines and banks located just outside of Fayette County are included in the tables under the nearest township of Fayette County.

Explanation of Table No. 1. The material in this table consists of the proximate and ultimate analyses, calorific values, moisture determination and ash softening temperatures as determined by the U. S. Bureau of Mines. The first column of the table gives the number used to refer to the bed section accompanying the analysis, the name of the mine or bank, the map location of the mine or bank in parentheses, the name of the coal bed and, when stated, if the analysis represents a composite sample for a mine or bank. The second column gives the U. S. Bureau of Mines analysis number. Where analyses of composite coal samples of a mine are listed, the coal section given is one believed to represent an average section for that mine. The coal sections to accompany the analyses of Table No. 1 are plotted and immediately follow the table.

All of the analyses listed in this table, with the exceptions of B 26a and B 26b of the Revere mine, represent channel samples of the entire thickness of the coal bed concerned. Analysis B 26a is of the breast coal and analysis B 26b is of the bearing-in and bottom coals of the lower division of the Pittsburgh bed. These are the only sectional bed analyses by the U. S. Bureau of Mines in Fayette County. Analyses of the Pittsburgh coal represent only the lower division of this bed as the roof coal or upper division is not commercially mineable.

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* From the U S. Bureau of Mines Report of Investigations, 3296.

The reader is referred for more detailed analyses and for moisture-free and moisture-and-ash-free calculations of the analyses to Pennsylvania Geological Survey Bulletin No. 6, Part IV, and to Analyses of Pennsylvania Bituminous Coals: U. S. Bureau of Mines Technical Paper 590. In the following table only "as received" analyses are given:

Table No. 1 Analyses of the various coal beds of Fayette County[1]

[Analyst—United States Bureau of Mines]

	Mine and bed	Anal. No.	Proximate				Ultimate					Air-drying loss	Calorific value		Softening[2] temperature °F.
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		British thermal units	Calories	
	BULLSKIN TOWNSHIP														
B1	Martin bank (Lc12) Brookville-Clarion coal	A95,567	1.8	25.1	57.5	15.6	1.1	4.5	71.8	1.2	5.8	1.3	12,700	7,056	2,960
B2	Soisson bank (Lc3) Lower Kittanning coal	A95,568	2.1	28.6	59.6	9.7	3.7	4.9	75.6	1.3	4.8	1.7	13,640	7,578	2,295
	DUNBAR TOWNSHIP														
B3	United Refractories mine (Jf3) Lower Kittanning coal	81,496	2.2	30.9	59.0	7.9	1.8					1.4	13,770	7,650	2,370
B4	Coffman mine (Je23) Lower Kittanning coal	81,495	2.3	30.0	57.6	10.1	4.3					1.7	13,340	7,411	2,050
B5	Ainsley mine (Je13) Lower Freeport coal (Composite)	81,341	3.0	27.6	56.5	12.9	1.2	4.9	72.1	1.3	7.6	2.0	12,790	7,106	2,765[3]
B6	Furnace No. 2 mine (Je21) Upper Freeport coal (Composite)	81,474	2.1	31.0	53.9	13.0	2.5	4.9	71.8	1.4	6.4	1.3	12,950	7,194	2,425[3]
B7	Leisenring No. 1 mine (Ie1) Pittsburgh coal	80,623	2.4	31.9	55.1	10.6	1.0	5.1	74.8	1.6	6.9	1.6	13,330	7,405	2,910
B8	Hairre mine (Ie3) Waynesburg coal (Composite)	81,338	3.2	29.6	44.6	22.6	3.2	4.6	61.4	1.3	6.9	1.9	11,130	6,183	2,280[3]
	FRANKLIN TOWNSHIP														
B9	Corrado No. 2 mine (Hc9) Lower Kittanning coal (Composite)	85,334	2.1	31.9	57.3	8.7	2.5	5.1	75.0	1.4	7.3	1.7	13,620	7,567	2,170[3]
B10	Walter mine (Fe12) Lower Bakerstown coal (Composite)	81.585	2.2	35.0	53.6	9.2	4.2	5.2	74.5	1.3	5.6	1.2	13.550	7.528	2.040[3]

Table No. 1 Analyses of the various coal beds of Fayette County[1]—Continued

	Mine and bed	Anal. No.	Proximate				Ultimate						Calorific value		
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-drying loss	British thermal units	Calories	Softening[2] temperature °F.
	GEORGES TOWNSHIP (All composite samples)														
B11	Oliphant mine (Gh11) Pittsburgh coal	84,884	2.9	30.9	60.0	6.2	1.0	5.3	77.7	1.7	8.1	2.4	13,890	7,717	2,690[3]
B12	Martin bank (Ei4) Pittsburgh coal	84,842	4.5	30.4	58.2	6.9	1.0	5.3	75.8	1.6	9.4	4.0	13,530	7,516	2,855[3]
B13	Deyarmon mine (Fh11) Sewickley coal	81,567	1.8	34.4	51.9	11.9	3.8	5.1	71.7	1.4	6.1	1.2	13,070	7,261	2,455[3]
B14	Swancy mine (Fi5) Sewickley coal	84,774	2.6	32.8	54.4	10.2	2.7	5.1	73.1	1.6	7.3	2.3	13,210	7,339	2,280[3]
B15	Jeffrey No. 1 mine (Gh8) Sewickley coal	84,846	3.8	34.1	52.0	10.1	2.7	5.3	72.5	1.6	7.8	3.3	13,180	7,322	2,290[3]
B16	Sapper mine (Eh6) Sewickley coal	84,414	2.6	35.7	53.2	8.5	3.3	5.2	74.6	1.5	6.9	2.3	13,510	7,506	2,325[3]
	GERMAN TOWNSHIP														
B17	Edenborn mine (Cg15) Pittsburgh coal	A64,467	1.6	33.6	57.6	7.2	1.1					0.8	13,940	7,744	2,660
B18	Gates No. 1 mine (Bg6) Pittsburgh coal (Composite)	84,197	1.9	33.5	58.2	6.4	0.9	5.2	78.1	1.7	7.7	1.4	13,990	7,769	2,595[3]
B19	Country bank (Ch7) Redstone coal	84,154	3.2	33.8	55.1	7.9	2.6					2.9	13,400	7,443	2,220
B20	Ross mine (Ch17) Sewickley coal (Composite)	84,153	4.1	33.3	49.1	13.5	2.2	5.1	68.1	1.4	9.7	4.0	12,500	6,942	2,225[3]
B21	Hartley mine (Cg10) Waynesburg coal (Composite)	84,259	3.7	31.9	51.2	13.2	1.3	5.0	69.3	1.6	9.6	2.9	12,380	6,881	2,625[3]

Table No. 1 Analyses of the various coal beds of Fayette County—Continued

	Mine and bed	Anal. No.	Proximate				Ultimate					Air-drying loss	Calorific value		Softening^2 temperature °F.
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		British thermal units	Calories	
	HENRY CLAY TOWNSHIP														
B22	Thomasdale mine (Oj2) Upper Freeport coal (Composite)	81,355	2.1	24.9	56.6	16.4	3.4	4.6	69.7	1.2	4.7	1.8	12,480	6,933	2,275^3
	LUZERNE TOWNSHIP														
B23	Hustead mine (Ae3) Pittsburgh coal (Composite)	23,097	2.5	35.7	53.6	8.2	1.8	5.2	76.2	1.5	7.1	1.2	13,650	7,583	2,285^3
	MENALLEN TOWNSHIP (Composite samples except B26a, b)														
B24	Valley mine (Fe9) Lower Bakerstown coal	84,990	1.7	35.5	54.1	8.7	3.4	5.2	75.1	1.2	6.4	1.4	13,690	7,606	1,890^3
B25	Beal mine (Fg3) Pittsburgh coal	84,895	3.5	32.1	58.2	6.2	0.8	5.3	77.4	1.7	8.6	2.5	13,810	7,672	2,910^3
B26	Revere mine (Fg4) Pittsburgh coal	A32,978	3.6	29.7	59.3	7.4	0.9	5.0	76.3	1.7	8.7	2.4	13,650	7,583	
B26a	Revere mine (Fg4) Pittsburgh coal (Breast or top bench)	A32,976	3.5	30.5	57.6	8.4	0.7	5.3	75.0	1.7	8.9	2.3	13,490	7,494	
B26b	Revere mine (Fg4) Pittsburgh coal (Bearing-in and bottom benches)	A32,975	3.6	29.5	61.2	5.7	0.7	5.3	78.2	1.7	8.4	2.4	13,990	7,772	
B27	Waltersburg Edna mine (Fe5) Pittsburgh coal	81,563	2.3	32.9	56.4	8.4	1.1	5.1	75.7	1.5	8.2	1.0	13,570	7,439	2,740^3
B28	Playford mine (Fg5) Sewickley coal	84,892	2.2	34.1	53.9	9.8	3.0	5.1	73.7	1.3	7.1	1.5	13,330	7,408	2,160^3

Table No. 1 Analyses of the various coal beds of Fayette County—Continued

	Mine and bed	Anal. No.	Proximate				Ultimate					Air-drying loss	Calorific value		Softening^2 temperature °F.
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		British thermal units	Calories	
	NICHOLSON TOWNSHIP (All composite samples)														
B29	Baxter Ridge No. 2 mine (Dj1) Pittsburgh coal	84,646	4.0	32.1	55.0	8.9	2.1	5.3	73.7	1.6	8.4	3.6	13,280	7,381	2,470^3
B30	Griffin No. 1 mine (Ch16) Pittsburgh coal	81,560	2.5	33.4	56.1	8.0	1.0	5.2	76.3	1.6	7.9	1.2	13,660	7,589	2,935^3
B31	Patrick No. 1 mine (Ch20) Sewickley coal	84,418	3.1	35.1	51.3	10.5	3.5	5.1	71.5	1.5	7.9	2.7	13,000	7,222	2,210^3
B32	Patrick No. 2 mine (Ci6) Sewickley coal	81,557	3.4	35.1	49.7	11.8	4.0	5.2	70.6	1.4	7.0	2.3	12,770	7,094	2,300^3
B33	Stevenson mine (Ci9) Sewickley coal	84,321	2.1	36.0	52.1	9.8	3.2	5.1	73.0	1.4	7.5	1.9	13,220	7,344	2,240^3
	NORTH UNION TOWNSHIP (All composite samples)														
B34	Springer mine (Ig3) Upper Freeport coal	84,951	2.7	28.1	55.1	14.1	3.8	4.7	70.2	1.2	6.0	2.4	12,560	6,978	2,165^3
B35	Ainsley mine (If) Pittsburgh coal	81,616	1.6	32.5	57.8	8.1	1.1	5.3	77.3	1.6	6.6	0.8	13,850	7,694	2,880^3
B36	Evans No. 3 mine (Hg3) Sewickley coal	85,321	2.0	32.6	54.8	10.6	3.0	5.0	73.7	1.5	6.2	1.8	13,310	7,394	2,240^3
B37	Gaddis mine (If8) Sewickley coal	81,500	1.8	32.7	53.7	11.8	3.3	5.0	72.2	1.5	6.2	1.2	13,070	7,261	2,280^3
	PERRY TOWNSHIP														
B38	Jacobs Creek Oil Co. (Gb2) Upper Freeport coal (Composite)	85,327	2.3	33.9	57.0	6.8	2.2	5.3	77.4	1.5	6.8	1.7	13,900	7,722	2,130^3

Table No. 1 Analyses of the various coal beds of Fayette County—Continued

	Mine and bed	Anal. No.	Proximate				Ultimate					Air-drying loss	Calorific value		Softening[2] temperature °F.
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen		British thermal units	Calories	
	REDSTONE TOWNSHIP														
B39	Albright farm bank (Dd8) Waynesburg coal	A95,404	2.1	34.9	49.3	13.7	2.8	5.1	70.0	1.6	6.8	1.3	12,700	7,056	2,520
B40	Belbois mine (Ed6) Waynesburg coal	84,987	3.2	33.0	53.1	10.7	1.4					2.7	12,780	7,100	2,370
B41	Cherry Camp mine (Ee1) Waynesburg coal	84,986	3.9	32.4	49.7	14.0	1.3					3.5	12,300	6,833	2,850
	SALTLICK TOWNSHIP														
B42	Kuhn No. 2 mine (Od8) Lower Kittanning coal (Composite)	81,470	2.7	22.7	67.2	7.4	2.3	4.8	78.9	1.4	5.2	1.9	13,990	7,772	2,255[3]
B43	Indian Creek No. 1 mine (Od4) Lower Kittanning coal (Composite)	A1,195	3.0	23.5	65.5	8.0	1.7	4.9	78.5	1.3	5.6	2.4	13,910	7,728	
B44	Melcroft mine (Oc6) Lower Kittanning coal (Composite)	A1,127	3.1	24.0	64.1	8.8	2.2	4.9	77.2	1.3	5.6	2.6	13,730	7,628	
B45	Miller bank (Pd2) Upper Freeport coal	A95,569	2.2	23.7	63.1	11.0	3.8	4.7	75.4	1.4	3.7	1.7	13,520	7,511	2,270
	SOUTH UNION TOWNSHIP														
B46	Meadowbrook mine (Gh1) Sewickley coal (Composite)	84,888	2.8	33.7	52.8	10.7	2.9	5.2	73.0	1.5	6.7	2.3	13,180	7,322	2,255[3]

Table No. 1 Analyses of the various coal beds of Fayette County—Continued

	Mine and bed	Anal. No.	Proximate				Ultimate						Calorific value		
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-drying loss	British thermal units	Calories	Softening^2 temperature °F.
	SPRINGFIELD TOWNSHIP (Composite samples except B51, 53, 55)														
B47	Stewarton mine (Mg1) Brockville-Clarion coal	81,344	2.5	24.1	59.9	13.6	5.0	4.7	71.4	1.2	4.1	1.4	12,850	7,139	2,285^3
B48	Penny mine (Mc6) Lower Kittanning coal	81,347	2.2	26.9	54.8	16.1	3.3	4.8	69.2	1.2	5.4	1.5	12,480	6,933	2,200^3
B49	Rose mine (Oc3) Lower Kittanning coal	81,483	3.3	19.0	56.1	21.6	5.6	4.1	62.9	1.1	4.7	2.0	11,350	6,305	2,450^3
B50	Rodgers No. 2 mine (Nc2) Lower Kittanning coal	81,477	2.7	24.2	64.3	8.8	2.3	4.7	77.8	1.4	5.0	1.8	13,760	7,644	2,320^3
B51	Rowan bank (Nf2) Upper Kittanning coal (Cannel coal)	A95,566	2.6	20.8	46.9	29.7	4.7	3.9	57.2	1.0	3.5	2.2	10,310	5,728	2,260
B52	Grimes mine (Nc10) Lower Freeport coal	81,480	2.8	24.6	62.3	10.3	2.9	4.8	74.6	1.4	6.0	1.7	13,370	7,428	2,120^3
B53	May bank (Mf2) Upper Freeport coal	A95,571	5.2	25.5	56.8	12.5	2.2	4.8	71.3	1.3	7.9	4.6	12,760	7,089	2,540
B54	Harbaugh bank (Mf1) Upper Freeport coal	A95,570	2.1	27.5	53.1	17.3	4.7	4.5	68.2	1.2	4.1	1.8	12,350	6,861	2,260
	SPRINGHILL TOWNSHIP (All composite samples)														
B55	Eagle mine (Dk8) Pittsburgh coal	84,592	2.6	35.2	54.4	7.8	2.3	5.3	76.0	1.6	7.0	2.1	13,710	7,619	2,360^3
B56	Atlantic No. 1 mine (Cj5) Pittsburgh coal	84,657	3.7	34.9	54.8	6.6	2.4	5.4	75.2	1.5	8.9	3.4	13,620	7,566	2,165
B57	Frederick No. 1 mine (Ck3) Pittsburgh coal	84,596	2.4	35.7	54.8	7.1	2.0	5.3	76.8	1.6	7.2	1.9	13,810	7,674	2,365^3
B58	Winstead mine (Bj1) Pittsburgh coal	84,532	3.6	34.4	55.5	6.5	1.9	5.5	75.8	1.6	8.7	3.0	13,640	7,576	2,275^3
B59	Hoffman mine (Cj3) Sewickley coal	84,628	3.0	35.1	52.0	9.9	2.7	5.3	72.5	1.5	8.1	2.5	13,160	7,308	2,255^3

Table No. 1 Analyses of the various coal beds of Fayette County—Concluded

	Mine and bed	Anal. No.	Proximate				Ultimate						Calorific value		
			Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	Air-drying loss	British thermal units	Calories	Softening[2] temperature °F.
	STEWART TOWNSHIP														
B60	Country bank (Lh4) Brookville-Clarion coal	A95,441	2.9	21.8	59.9	15.4	4.0	4.5	70.3	1.1	4.7	2.6	12,650	7,028	2,380
B61	Stull mine (Mg4) Brookville-Clarion coal (Composite)	81,359	3.4	25.1	60.8	10.7	1.1	4.9	73.8	1.1	8.4	3.1	13,320	7,400	2,325[3]
B62	Jim Run mine (Mg9) Lower Kittanning coal (Composite)	81,486	3.0	24.2	61.1	11.7	4.0	4.7	73.0	0.9	5.7	2.2	13,150	7,306	2,165[3]
B63	Torrence mine (Lh7) Lower Kittanning coal (Composite)	81,362	3.1	25.9	64.2	6.8	1.9	5.2	78.6	1.4	6.1	2.5	13,990	7,772	2,435[3]
B64	Whipkey bank (Lh6) Lower Kittanning coal	A95,440	2.7	24.7	64.4	8.2	2.7	5.0	78.2	1.3	4.6	2.3	14,000	7,778	2,440
B65	Bailey mine (Mb4) Lower Freeport coal (Composite)	81,489	2.6	23.8	58.6	15.0	2.4	4.6	71.0	1.2	5.8	1.7	12,590	6,994	2,505[3]
B66	Stull bank (Mg2) Lower Freeport coal	81,356	3.3	28.9	61.4	6.4	2.9					2.6	13,920	7,733	2,240
B67	Potter bank (Mh8) Upper Freeport coal	A95,442	3.3	25.0	62.3	9.4	3.1	4.9	76.3	1.4	4.9	2.8	13,610	7,561	2,440

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[1] Analyses quoted on "as received" basis.
[2] Temperature at which the cone of coal ash has been fused down to a spherical lump when heated in a slightly reducing temperature.
[3] Average ash softening temperature.

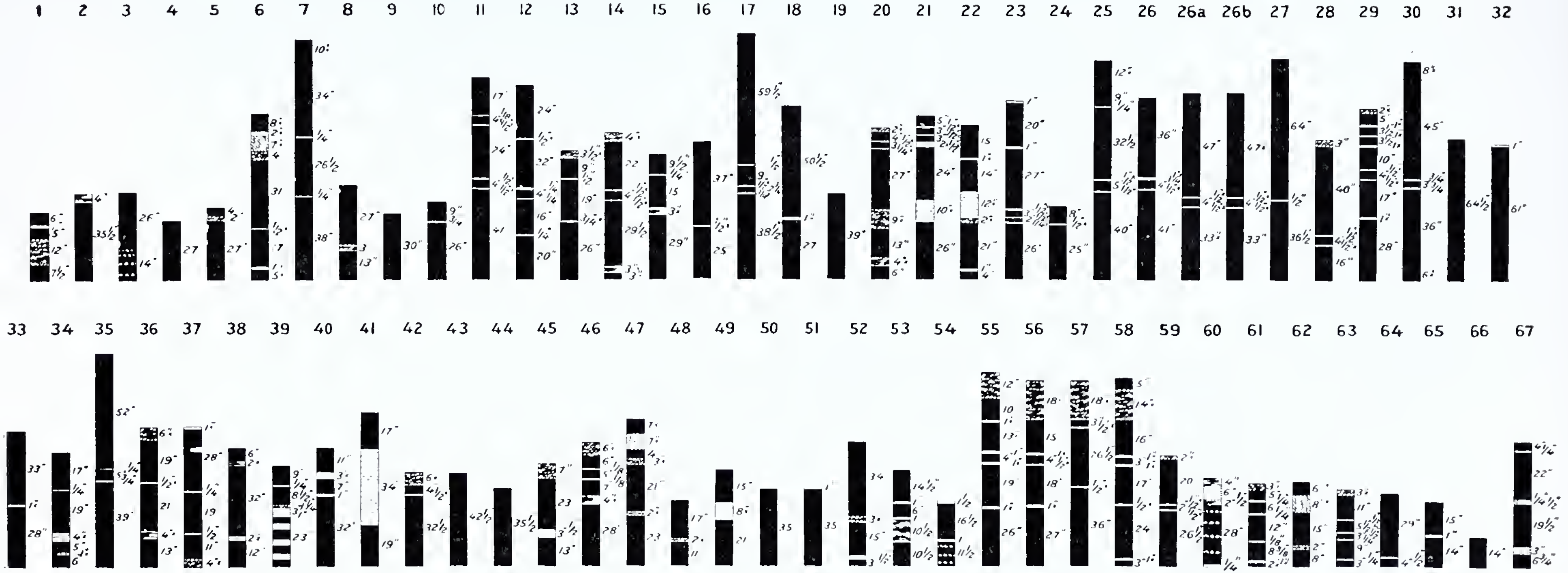

Figure 130. Sections of coal beds whose analyses are given in Table 1.

Explanation of Table No. 2. This table lists proximate analyses of the various coal beds of Fayette County as sampled and analyzed by coal company employes. The sampling practice of the H. C. Frick Coke Co. is to take a small channel sample from top to bottom of the coal bed, removing only enough coal to form a good-sized sample, with no quartering of the sample required. As the percentage of moisture is not determined, the sample is not sealed in an air-tight container when it is collected.

Many of the analyses listed in Table No. 2 are of the sectional bed type; that is, the entire coal bed is divided into sections and a sample taken and analysis made of each section. The value of this type of sampling and analyzing of a coal bed is clearly illustrated by some of the Pittsburgh coal analyses in Luzerne and German townships.

The most complete sectional bed analyses consist of five sections from top to bottom of the bed, the 1st top (6″), 2d top (6″), middle section, 2d bottom (4″), and 1st bottom (4″). This, however, is not a standard division, and in the table, beds divided into two, three, four, or five sections of differing thicknesses are to be found. Consequently, the various bed sections are designated as follows: A for the top section, C for the middle section, E for the bottom section, and B and D for the intermediate sections. Thus, a five-section analysis is lettered A, B, C, D and E from top to bottom, a four-section analysis, A, B, D and E, a three-section analysis, A, C and E, and a two-section analysis is lettered A and E. These letters are listed in column 3 of the table and are also marked with the proper thicknesses on the plotted coal sections that accompany these analyses and immediately follow the table. When letters are not given, the analysis is the usual channel sample of the total thickness of the bed.

Column 1 lists the number used to refer to the plotted bed section accompanying the analysis, the name of the mine or bank, the map location in parentheses, the name of the coal bed and, when determined, the B.t.u. value of the coal. The remaining columns, in order, list the bed section, the percentage of volatile matter, fixed carbon, ash, sulphur, and phosphorus in the coal. Company analysts determine phosphorus as it is an undesirable constituent of coal that is to be used for the manufacture of coke. Plotted sections of coal beds where samples were collected are given in Figure 131.

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County

[Analyst—H. C. Frick Coke Co.]

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
BULLSKIN TOWNSHIP						
1 Long bank (Mb2)						
Mercer coal		26.8	64.0	9.2	2.3	0.02
2 Country bank (Mb3)	A	29.2	61.8	9.0	6.1	0.01
Mercer coal	E	27.0	60.9	12.1	2.5	0.01
3 Ringgrove mine (Lb)	A	28.4	67.3	4.3	1.5	0.01
Brookville-Clarion coal	E	27.2	65.4	7.4	2.0	0.01
4 Ringgrove mine (Lb)	A	28.5	65.4	6.0	3.3	0.01
Brookville-Clarion coal	E	28.1	61.4	10.4	3.5	0.01
5 Skemp & Staffer bank (Lb5)						
Lower Kittanning coal		26.2	63.2	10.6	0.7	0.05
6 Clark bank (Lb)						
Lower Kittanning coal		30.9	53.5	15.7	0.4	0.02
7 Swink bank (Lc5)	A	25.8	61.1	13.2	2.2	0.01
Lower Kittanning coal	E	30.3	65.3	4.5	1.9	0.01
Composite		29.0	64.0	7.0	2.0	0.01
B. t. u.: A 12,305						
E 14,330						
8 Soisson bank (Lc7)						
Lower Kittanning coal		27.9	63.5	8.6	1.4	0.01
9 Stillwagon bank (Lc8)	A	23.3	58.1	18.6	5.4	0.02
Lower Kittanning coal	E	27.5	64.5	8.1	3.3	0.03
10 Country bank (Lc9)						
Upper Freeport coal		26.5	55.1	18.4	4.3	0.02
11 Country bank (Lc10)						
Upper Freeport coal		26.9	54.8	18.4	0.4	0.03
12 Hatfield bank (Lc3)						
Upper Freeport coal		28.7	55.5	15.8	4.0	0.01
13 Country bank (Lc4)						
Upper Freeport coal		25.4	61.6	13.0	1.2	0.02
CONNELLSVILLE TOWNSHIP						
14 Newcomer bank (Kd)						
Brookville-Clarion coal		26.4	58.2	15.4	6.7	0.01
15 Reed bank						
Brookville-Clarion coal		27.0	56.8	16.2	6.7	0.03
16 Country bank (Kd)						
Brookville-Clarion coal		30.9	58.0	11.1	6.8	0.01
17 Snader bank (Je)						
Brookville-Clarion coal		32.1	59.8	8.1	2.6	0.02
B. t. u. 14,048						
18 Snader bank (Kd)						
Brookville-Clarion coal		29.8	61.8	8.4	2.9	0.01
B. t. u. 14,125						
19 Snader Custom bank (Kd7)						
Lower Kittanning coal		28.8	62.7	8.5	3.2	0.01
20 Snader Custom bank (Kd7)	A	26.4	53.4	20.2	2.7	0.02
Lower Kittanning coal	E	30.7	62.2	7.1	3.3	0.02
21 Soisson bank (Ke2)						
Lower Kittanning coal		27.0	62.9	10.1	3.3	0.01
22 Country bank (Je4)						
Lower Kittanning coal		30.3	63.8	5.9	2.8	0.01
23 Pierce bank (Kd10)						
Upper Freeport coal		28.1	62.5	9.4	2.4	0.02
24 Frick bank (Je)						
Upper Freeport coal				12.9	1.7	0.01
25 Barryhill bank (Ke1)						
Upper Freeport coal		29.2	63.5	7.3	1.3	0.02
26 Long bank (Jc17)						
Sewickley coal		27.7	49.7	22.6	2.4	0.02

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
DUNBAR TOWNSHIP						
27 United Refractories mine (H3) (North opening)						
Lower Kittanning coal		28.5	62.1	9.5	3.7	0.02
28 United Refractories mine (Jf4) (South opening)						
Lower Kittanning coal		28.8	60.4	10.8	3.5	0.01
29 Hurd mine (Je10)						
Upper Freeport coal		30.8	60.2	9.0	1.9	0.01
B. t. u. 13,971						
30 Hurd mine (Je2)						
Upper Freeport coal		28.8	58.7	12.5	2.2	0.02
B. t. u. 13,492						
31 Furnace No. 1 (Je12)	A	28.5	62.5	9.0	1.4	0.02
Upper Freeport coal	E	30.9	62.6	6.5	1.6	0.01
Composite		29.2	62.5	8.3	1.4	0.02
32 Furnace No. 1 (Je12)	A	28.4	64.3	7.3	0.8	0.03
Upper Freeport coal	E	29.5	63.4	7.1	1.5	0.01
Composite		28.8	64.0	7.2	1.0	0.02
FRANKLIN TOWNSHIP						
33 Keedy Coal Co. mine (Fe13)						
Lower Bakerstown coal		34.9	57.1	8.0	3.9	0.01
B. t. u. 13,740						
34 Colonial No. 1 mine (Fd4)	A			6.0	2.1	
Pittsburgh coal	B			5.9	1.3	
	C			7.6	0.9	
	D			6.9	1.3	
	E			13.0	3.0	
Composite		33.5	59.0	7.5	1.1	0.01
Range[3]: Minimum		30.4	54.3	6.9	1.1	0.01
Range[3]: Maximum		33.5	61.2	15.3	1.5	0.03
GEORGES TOWNSHIP						
35 Frick bank (Gi1)	A	31.2	58.2	10.6	3.6	0.01
Upper Freeport coal	E	27.4	51.6	21.0	5.9	0.01
36 Frick bank (Gi1)						
Upper Freeport coal		30.4	57.4	12.2	3.9	0.01
37 Hardin bank (Gi2)	A	29.9	60.2	9.9	3.0	0.02
Upper Freeport coal	E	29.4	58.5	12.1	3.1	0.01
38 Hardin bank (Gi2)						
Upper Freeport coal		28.8	61.9	9.3	2.3	0.02
39 Laughead mine (Gh4)						
Sewickley coal		33.8	56.4	9.8	3.6	0.02
40 Hustead bank (Gh10)						
Sewickley coal		30.5	58.1	11.5	3.4	0.02
41 Robinson bank (Fh13)						
Sewickley coal		30.2	56.4	13.4	4.1	0.01
42 Collier bank (Fh4)	A	36.9	42.1	21.0	1.1	0.07
Sewickley coal	B	32.8	61.8	5.4	1.8	0.01
	D	31.1	56.4	12.5	2.0	0.01
	E	28.6	50.1	21.3	2.0	0.04
Average		32.2	52.6	15.1	1.7	0.03
43 Moore bank (Fi2)						
Sewickley coal		32.8	58.5	8.7	2.0	0.03
B. t. u. 13,270						
44 Reilley bank (Eh7)	A	30.3	46.4	23.3	2.8	0.03
Sewickley coal	B	35.5	54.7	9.8	2.6	0.01
	C	35.4	55.5	9.2	3.2	0.01
	D	33.3	51.8	15.0	5.2	0.01
	E	27.1	42.0	30.9	6.2	0.03
Composite		34.2	53.4	12.4	3.4	0.01
45 Nellie mine (Eh9)	A	35.3	50.7	14.0	2.4	0.01
Sewickley coal	C	35.7	55.5	8.8	2.7	0.01
	E	29.8	43.6	26.7	4.4	0.01
Composite		34.8	53.1	12.2	2.9	0.01

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
GEORGES TOWNSHIP—Continued						
46 Hope mine (Eh12)	A	31.9	60.1	8.0	1.6	0.01
Sewickley coal	C	31.7	59.2	9.1	2.4	0.01
	E	30.5	52.2	17.3	4.4	0.01
Composite		31.6	58.5	10.0	5.4	0.01
47 Hope mine (Eh12)	A	36.3	53.0	10.7	2.4	0.01
Sewickley coal	B	36.7	55.8	7.5	4.1	0.01
	C	35.1	56.0	8.9	3.3	0.01
	D	33.2	55.9	11.0	3.5	0.01
	E	32.9	52.3	14.8	8.1	0.01
Composite		35.1	55.4	9.5	3.6	0.01
GERMAN TOWNSHIP						
48 Crawford mine (Dh11)						
Pittsburgh coal		34.3	59.0	6.7	0.9	0.01
B. t. u. 14,113 to 14,225						
Range[4]: Minimum		31.6	59.0	6.7	0.8	0.01
Range[4]: Maximum		34.3	61.0	7.4	0.9	0.02
49 Boyd mine (Cg9)						
Waynesburg coal		29.9	51.1	19.0	1.5	0.05
50 Gray mine (Cg13)						
Waynesburg coal		29.5	50.8	19.7	1.1	0.04
51 Gray mine (Cg13)	A	28.5	44.5	27.0	0.9	0.11
Waynesburg coal	C	33.1	53.2	13.7	0.8	0.09
	E	29.5	49.7	20.8	0.9	0.05
52 Hartley mine (Cg10)	A	29.9	49.5	20.6	1.3	0.07
Waynesburg coal	E	32.0	54.0	14.0	1.8	0.01
Composite		30.7	51.0	18.3	1.5	0.09
B. t. u.: A 11,865						
B. t. u.: E 13,003						
B. t. u.: Composite 12,225						
53 Ida mine (Cg14)						
Waynesburg coal		29.0	44.5	26.6	3.2	0.03
B. t. u. 10,485						
JEFFERSON TOWNSHIP						
54 Fayette mine (Ec2)	A			6.7	2.1	
Pittsburgh coal	B			6.1	1.4	
	C			7.2	1.0	
	D			10.6	1.0	
	E			21.8	1.8	
Composite		33.4	58.9	7.7	1.2	0.03
Range[5]: Minimum		32.8	57.4	6.6	0.9	0.01
Range[5]: Maximum		34.9	59.5	8.5	1.5	0.03
55 Colonial No. 4 mine (Ed23)	A			8.0	1.1	
Pittsburgh coal	B			7.5	1.0	
	C			7.8	1.2	
	D			9.4	1.6	
	E			13.1	3.0	
Composite		33.4	58.6	8.1	1.2	0.03
Range[5]: Minimum		32.5	56.2	7.0	1.1	0.01
Range[5]: Maximum		36.2	59.6	8.3	1.5	0.03
LOWER TYRONE TOWNSHIP						
56 Country bank (Hb) South Huntingdon Township, Westmoreland County						
Lower Kittanning coal		31.0	59.3	9.7	0.8	0.01
57 Lauenberger bank (Hb)						
Upper Freeport coal		34.0	56.1	7.9	3.4	0.01
58 Minister bank (Ib) East Huntingdon Township, Westmoreland County						
Upper Freeport coal		36.3	54.2	9.5	5.1	0.01

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
LUZERNE TOWNSHIP						
59 Melrose mine (Be1)	A	34.4	52.4	13.2	3.3	
Pittsburgh coal	B	33.1	51.7	15.2	2.5	
	C	33.5	58.0	8.5	1.5	
	D	33.5	54.6	11.9	3.4	
	E	30.7	51.5	17.9	3.0	
Composite		33.4	56.8	9.8	1.8	
60 Melrose mine (Be1)	A	33.2	51.5	15.3	2.5	
Pittsburgh coal	B	32.2	52.5	15.3	3.4	
	C	36.9	54.0	9.1	1.4	
	D	35.3	54.9	9.9	2.0	
	E	32.2	52.6	15.3	5.3	
Composite		36.1	53.7	10.2	1.8	
61 Melrose mine (Be1)						
Pittsburgh coal		33.3	56.0	10.7	2.2	
Average[6]				9.4	1.9	0.01
62 Luzerne mine (Ad1)	A			17.5	3.3	0.01
Pittsburgh coal	C	34.7	55.7	9.6	1.9	0.01
	E			4.7	1.4	0.01
Composite				9.8	2.0	0.01
63 Thompson No. 1 mine (Cf7)						
Pittsburgh coal		34.9	58.1	7.0	0.9	0.01
64 Thompson No. 1 mine (Cf7)	A			4.5	1.2	0.07
Pittsburgh coal	C	35.3	57.8	6.9	1.2	0.01
	E			14.2	2.7	0.01
Composite				7.2	1.3	0.01
65 Thompson No. 2 mine (Cf5)						
Pittsburgh coal		35.5	57.4	7.1	1.2	0.01
66 Tower Hill No. 2 mine (Ce16)	A	34.7	52.8	12.5	4.9	0.01
Pittsburgh coal	E	33.5	59.3	7.2	0.9	0.01
Composite		33.6	58.9	7.5	1.2	0.01
67 Isabella mine (Bf5)						
Pittsburgh coal		35.0	55.3	9.7	2.5	0.01
68 Isabella mine (Bf5)	A			11.1	4.0	0.12
Pittsburgh coal	B			11.8	2.1	0.06
	C	34.1	58.1	7.8	1.6	0.01
	D			16.5	2.9	0.01
	E			15.9	3.6	0.01
Composite				9.0	1.9	0.02
69 Hustead mine (Ae3)						
Pittsburgh coal		35.6	53.9	10.5	2.4	0.01
70 LaBelle mine (Ad3)						
Pittsburgh coal		35.2	54.8	9.9	2.4	0.01
71 Allison No. 2 mine (Ce12)						
Pittsburgh coal		35.5	56.1	8.4	1.3	0.02
72 Sarah bank (Be20)						
Waynesburg coal		33.2	46.8	20.0	3.7	0.02
72a Sarah bank (Be20)	A	36.9	43.1	20.0	5.6	0.01
Waynesburg coal	E	33.6	44.6	21.8	6.6	0.01
73 Arensburg mine (Bf1)	A	28.9	48.8	22.3	4.0	0.01
Waynesburg coal	E	34.8	50.0	15.2	3.3	0.04
74 Frances mine (Ae13)						
Waynesburg coal		34.3	49.7	16.0	2.7	0.02
74a Frances mine (Ae13)	A	29.3	39.5	31.1	4.7	0.02
Waynesburg coal	E	34.9	49.6	15.5	3.2	0.04
NICHOLSON TOWNSHIP						
75 Leckrone stripping (Di2)						
Pittsburgh coal						
Range[7]: Minimum		31.7	53.5	6.9	0.8	
Maximum		36.8	60.8	8.8	1.2	
Average		33.3	54.7	7.8	1.1	

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
NORTH UNION TOWNSHIP						
76 Beaty bank (Hh4)	A	27.4	55.7	16.9	6.8	0.01
Brookville-Clarion coal	E	29.1	57.3	13.7	2.7	0.01
77 Frederick bank (Ig2)	A	30.0	61.8	8.3	3.7	0.02
Brookville-Clarion coal	E	22.0	46.9	31.1	1.7	0.08
78 Frederick bank (Ig2) Brookville-Clarion coal		28.7	59.3	12.0	4.8	0.01
79 Frederick bank (Ig4) Lower Kittanning coal		28.0	59.6	12.4	1.0	0.09
80 Thomas bank (Ig1) Upper Freeport coal		30.3	59.1	10.6	3.0	0.01
81 Thomas bank (Ig1) Upper Freeport coal		31.2	58.6	10.2	3.2	0.01
82 Hogsett mine (Hf5) Sewickley coal B. t. u. 13,160		34.5	53.4	12.1	3.4	0.01
83 Hogsett mine (Hf5) Sewickley coal B. t. u. 12,995		34.0	54.5	11.5	4.0	0.01
84 Country bank (Hf) Sewickley coal B. t. u. 13,640		34.5	54.8	10.7	2.9	0.01
85 Polecat mine (Hg) Sewickley coal		34.0	54.0	12.0	4.8	0.01
86 Ray No. 1 mine (Hg) Sewickley coal		31.1	54.4	14.6	4.0	0.01
87 Murphy mine (Hg) Sewickley coal		32.0	52.0	16.0	3.5	0.04
88 Davis bank (Hg) Sewickley coal		33.1	53.3	13.6	4.1	0.01
89 Barnes bank (Hg) Sewickley coal		33.6	54.3	12.1	1.9	0.02
90 Sadie mine (Gg7) Sewickley coal B. t. u. 13,610		30.8	58.2	11.0	2.9	0.01
91 Sadie mine (Gg7) Sewickley coal B. t. u. 13,400		31.7	56.4	11.9	2.9	0.01
92 Pope bank (Hc5) Waynesburg coal		29.6	52.9	17.5	2.8	0.01
REDSTONE TOWNSHIP						
93 Tower Hill No. 1 mine (Cf1)	A	36.2	55.7	8.1	2.6	0.12
Pittsburgh coal	C	34.2	58.3	7.5	0.9	0.01
	E	34.1	60.2	5.7	0.7	0.01
Composite		34.3	58.4	7.3	1.0	0.02
94 Tower Hill No. 1 mine (Cf1) Pittsburgh coal		35.2	57.4	7.4	1.4	0.01
95 Allison No. 1 mine (Dc3)	A	36.7	52.6	10.6	3.4	0.06
Pittsburgh coal	B	36.0	55.0	9.0	3.6	0.08
	C	35.1	57.2	7.8	1.8	0.01
	D	34.8	56.6	8.6	1.5	0.01
	E	33.3	53.4	13.3	3.3	0.05
Composite		34.8	57.0	8.2	2.0	0.02
96 Allison No. 1 mine (Dc3)	A	36.2	54.9	8.9	2.9	0.10
Pittsburgh coal	B	34.1	58.1	7.8	2.8	0.05
	C	32.5	59.0	8.5	1.5	0.01
	D	32.5	60.1	7.5	1.3	0.01
	E	31.9	57.3	10.8	1.9	0.03
Composite		32.2	59.2	8.6	1.7	0.02
97 Royal mine (Ee3)	A	35.0	55.2	9.7	2.9	0.02
Pittsburgh coal	B	35.9	58.2	6.0	1.7	0.05
	C	33.5	58.1	8.3	1.1	0.01
	D	34.4	59.9	5.7	0.8	0.01
	E	30.0	51.5	18.5	2.4	0.05
Composite		34.1	57.3	8.6	1.3	0.01

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
NORTH UNION TOWNSHIP—Continued						
98 Royal mine (Ee3)	A	33.3	53.5	13.3	4.0	0.04
Pittsburgh coal	B	35.1	57.3	7.5	1.9	0.04
	C	33.2	60.4	6.4	1.0	0.01
	D	34.0	60.5	5.5	0.8	0.01
	E	31.4	56.1	12.4	1.5	0.03
Composite		34.0	58.7	7.3	1.3	0.01
Range[8]: Minimum		33.3	57.3	7.1	1.0	0.01
Range[8]: Maximum		34.2	59.6	8.6	1.7	0.02
SALTLICK TOWNSHIP						
99 Gatorka mine (Mc4)						
Brookville-Clarion coal		28.8	55.9	15.3	3.5	0.02
100 Yother bank (Oc1)	A	22.4	67.0	10.6	0.7	0.02
Lower Kittanning coal	E	23.3	66.1	10.6	0.8	0.01
101 Ritenour bank (Oc)						
Lower Kittanning coal		23.4	70.2	6.5	1.1	0.03
102 Mowery bank (Nc9)						
Lower Kittanning coal		27.8	63.0	9.2	1.4	0.06
103 Miller bank (Nc7)						
Lower Kittanning coal		28.1	65.1	6.8	1.2	0.04
104 Kessler bank (Nb3)	A	22.8	63.5	13.7	1.0	0.16
Lower Kittanning coal	E	26.3	69.2	4.5	1.3	0.05
Composite		25.1	67.3	7.6	1.2	0.08
105 Adams bank (Pc7)						
Upper Freeport coal		23.8	67.2	9.0	3.3	0.01
106 Dumbold bank (Pd)						
Upper Freeport coal		23.9	68.5	7.7	2.1	0.01
107 White bank (Nc3)						
Upper Freeport coal		31.3	59.8	8.8	2.1	0.03
108 Lauer bank (Nd1)	A	25.5	64.0	10.5	1.9	0.02
Upper Freeport coal	E	26.0	68.0	6.0	1.7	0.01
Composite		25.8	66.6	7.6	1.8	0.01
109 Country bank (Nc5)	A	24.5	64.7	10.9	0.5	0.01
Upper Freeport coal	E	25.9	69.8	4.2	1.7	0.01
110 Richter bank (Nc4)						
Upper Freeport coal		27.3	63.9	8.8	2.8	0.02
SOUTH UNION TOWNSHIP						
111 Rankin bank (Hh2)	A	30.8	55.9	13.5	5.0	0.01
Upper Freeport coal	E	26.7	56.0	17.3	4.5	0.01
112 Rankin bank (Hh2)						
Upper Freeport coal		27.1	62.1	10.8	3.7	0.01
113 Barnes bank (Hh2)						
Upper Freeport coal		30.8	54.6	14.6	5.7	0.01
114 Barnes bank (Hh2)						
Upper Freeport coal		30.0	57.8	12.3	4.2	0.01
115 Oolery bank (Hh7)	A	29.0	58.1	13.0	0.4	0.01
Upper Freeport coal	B	27.6	56.7	15.7	0.5	0.01
	D	27.0	59.5	13.4	0.5	0.01
	E	27.2	49.1	23.7	0.5	0.01
116 Oolery bank (Hh7)	A	30.5	59.7	9.8	2.5	0.01
Upper Freeport coal	E	27.9	55.8	16.3	3.1	0.01
117 Evans bank (Hh8)	A	27.7	61.3	11.0	0.6	0.01
Upper Freeport coal	E	27.6	55.9	16.5	0.6	0.01
118 Marie mine (Gg8)						
Sewickley coal		31.8	58.5	9.8	2.5	0.01
119 Marie mine (Gg8)	A	36.1	54.6	9.3	3.2	0.01
Sewickley coal	B	34.8	56.4	8.7	2.3	0.01
	C	33.8	55.1	11.1	2.7	0.01
	D	30.7	52.7	16.6	7.7	0.01
	E	27.2	46.5	26.3	5.0	0.01
Composite		33.5	54.5	12.1	3.2	0.01

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Continued

Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
SOUTH UNION TOWNSHIP Continued						
120 Martha mine (Gg9) Sewickley coal		33.3	53.6	13.2	3.2	0.01
121 Meadowbrook mine (Gh1) Sewickley coal B. t. u. 13,190		31.5	55.2	13.3	2.9	0.01
122 Rankin bank (Gh5) Sewickley coal		33.9	55.4	10.8	3.0	0.02
123 Continental No. 1 shaft (Gg3) Sewickley coal		33.0	56.0	11.0	3.7	0.01
124 Redstone air shaft (Gg5) Sewickley coal B. t. u. 12,524		32.9	53.8	13.3	4.4	0.01
125 Redstone air shaft (Gg5) Sewickley coal		30.3	57.0	12.7	6.7	0.01
SPRINGFIELD TOWNSHIP						
126 Firestone bank (Md2) Brookville-Clarion coal		26.3	58.6	15.1	4.1	0.03
127 Warrick bank (Mg) Lower Kittanning coal		23.4	64.7	11.9	4.2	0.01
128 Rodgers bank (Ne2) Lower Kittanning coal		21.6	70.1	8.3	2.1	0.03
129 Morse bank (Md1) Lower Kittanning coal		26.0	65.1	8.9	0.8	0.07
130 Cox bank (Me) Brookville-Clarion coal		24.4	64.6	11.1	3.5	0.01
131 Printy bank (Ne9) Upper Freeport coal		23.2	69.4	7.3	2.6	0.01
132 Printy bank (Ne11) Upper Freeport coal		22.9	67.3	9.8	2.9	0.02
133 Johnson bank (Nf3) Upper Freeport coal		25.2	58.3	16.5	5.2	0.01
134 Showman bank (Oe5) Upper Freeport coal		23.0	66.3	10.7	2.5	0.02
135 Shemar bank (Ne13) Upper Freeport coal		22.6	71.4	6.0	0.8	0.01
SPRINGHILL TOWNSHIP						
136 Everhart bank (Cl) Pittsburgh coal		35.7	57.2	7.2	2.7	0.02
137 Grimes bank (Cl) Pittsburgh coal		36.4	55.9	7.7	2.6	0.01
138 Crow bank (Bl) Pittsburgh coal		35.2	58.3	6.6	1.3	0.01
139 Lynn bank (Ek1) Pittsburgh coal		35.6	55.8	8.6	3.1	0.01
140 Conn bank (Ck) Pittsburgh coal		34.4	59.6	6.1	1.8	0.01
141 Day bank (Ck1) Pittsburgh coal		33.9	55.1	11.0	3.8	0.01
142 Hill mine (Dk9) Pittsburgh coal		33.4	56.9	9.7	2.4	0.01

Table No. 2 Sectional and composite proximate analyses of the various coal beds in Fayette County—Concluded

	Mine and bed	Bed[2] Sec.	V. M.	F. C.	Ash	Sul.	Phos.
	UPPER TYRONE TOWNSHIP						
143	Diamond drill hole (Ka1) East Huntingdon Township, Westmoreland County Upper Freeport coal		30.6	57.5	11.8	3.4	0.01
144	Hribal bank (Ka)	A	31.4	51.4	17.2	2.9	0.01
	East Huntingdon Township, Westmoreland County Sewickley coal	B	32.3	52.0	15.7	2.6	0.01
		C	30.0	51.8	18.2	2.7	0.01
		D	31.9	52.6	15.6	5.0	0.01
		E	30.2	47.5	22.3	3.3	0.01
	Composite		30.4	51.6	18.0	2.8	0.01
145	Hribal bank (?) Sewickley coal		30.3	51.2	18.6	2.1	0.01
146	Smith bank (?) Sewickley coal		31.2	55.2	13.6	3.4	0.01
	WASHINGTON TOWNSHIP						
147	Diamond drill hole (Ca1) Fallowfield Township, Washington County Upper Freeport coal		33.3	57.9	8.8	1.8	0.02
	WHARTON TOWNSHIP						
148	Johnson bank (Ih) Brookville-Clarion coal		26.6	50.2	23.1	5.3	0.02
149	Nelson bank (Ij) Brookville-Clarion coal	A	25.6	63.7	10.6	2.8	0.01
		E	26.4	62.3	11.3	2.7	0.01
150	Lambert bank (Ij) Lower Kittanning coal		27.2	64.5	8.3	2.6	0.01
151	Carrol bank (Jj4) Upper Freeport coal		24.5	64.6	10.9	4.3	0.01
152	Carrol bank (Jj4) Upper Freeport coal		23.2	66.8	10.0	3.7	0.01
153	Gray bank (Ki) Lower Bakerstown coal		27.4	66.5	6.2	0.7	0.01

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[1] Analyses quoted on "as received" basis.

[2] Letters refer to section of bed from which the analyzed sample was taken. See complete bed section on Figure 131.

[3] Range of 10 composite samples.

[4] Range of 3 channel samples.

[5] Range of 12 composite samples.

[6] Average of 18 channel samples.

[7] Range and average of 15 channel samples.

[8] Range of 8 channel samples.

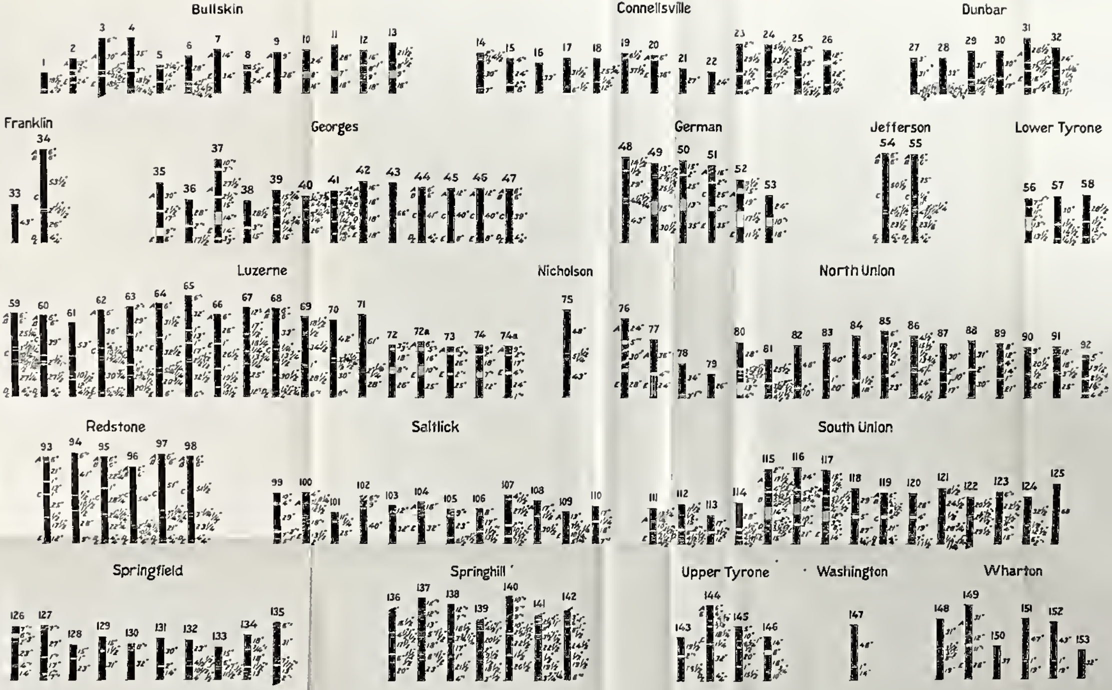

Figure 131. Sections of coal beds whose analyses are given in Table 2.

Explanation of Table No. 3. This table contains sectional-bed, incomplete analyses that list only ash, sulphur, and phosphorus content of the Pittsburgh, Redstone, and Sewickley coals. The sampling and analyzing of the coals were done by coal company employes. The first column gives the number used to refer to the plotted bed section accompanying the analysis, the mine or bank name, the map location in parentheses, the name of the coal bed and when determined the B.t.u. value of the coal. Column 2 lists the determinations made for each mine and the following five columns list these determinations for the respective sections (A, B, C, D and E) of the bed as explained for Table No. 2. The composite column lists the results of analysis of the composite sample. The last three columns of the table give the range and average of several analyses of channel samples of the entire bed for the particular mine. Plotted sections of coal beds where samples were collected are given on Figure 132.

Table No. 3 Sectional and composite analyses showing ash, sulphur and phosphorus in the Pittsburgh, Redstone and Sewickley coals in various mines in Fayette County[1]

[Analyst—H. C. Frick Coke Co.]

Mine and bed		A	B	C	D	E	Composite	Range	Average	Number[2] of samples
GEORGES TOWNSHIP										
1 Continental No. 3 mine (Eg9)	Ash	14.5	14.1	7.3	12.2	20.7	8.9	5.8–10.4	7.2	
Pittsburgh coal	Sulphur	0.8	0.6	0.7	1.5	5.2	0.9	0.9– 3.0	1.4	20
	Phosphorus	0.03	0.04	0.02	0.01	0.01	0.02			
2 Kyle mine (Fi3)	Ash	12.1		7.2		11.4	7.7	5.8–13.9	7.6	
Pittsburgh coal	Sulphur	2.2		1.4		2.5	1.5	0.7– 3.1	1.4	62
	Phosphorus	0.01		0.02		0.01	0.02			
3 Newcomer bank (Fg7)	Ash	18.9	8.0	9.3	18.9	26.8	11.5			
Sewickley coal	Sulphur	2.9	2.7	4.3	6.3	5.5	4.3			
B. t. u. 12,990	Phosphorus	0.01	0.01	0.01	0.01	0.01				
4 Collier bank (Fh4)	Ash	19.0	10.5	11.1	8.5	17.1	12.0			
Sewickley coal	Sulphur	1.3	2.1	2.4	2.7	4.5	2.4			
	Phosphorus	0.16	0.05	0.02	0.01	0.01	0.03			
5 Sangston bank (Eg10)	Ash	13.5	8.4	10.8	16.5	22.8	11.0			
Sewickley coal	Sulphur	2.3	2.2	4.0	5.4	5.5	3.7			
B. t. u. 13,310	Phosphorus	0.04	0.01	0.01	0.01	0.01				
GERMAN TOWNSHIP										
6 Donald No. 3 mine (Bh6)	Ash	9.2		8.6		6.0	8.5			
Pittsburgh coal	Sulphur	4.2		1.7		2.3	2.0			
	Phosphorus	0.03		0.02		0.01	0.02			
7 Donald No. 4 mine (Bh3)	Ash	12.3	22.6	8.4	11.1	16.5	9.9			
Pittsburgh coal	Sulphur	6.1	4.6	2.1	3.2	5.7	2.7			
	Phosphorus	0.03	0.04	0.01	0.01	0.05	0.02			
8 Leckrone No. 2 mine (Dh7)	Ash	11.7	8.6	6.8	11.2	15.3	7.6	5.3–10.7	8.0	
Pittsburgh coal	Sulphur	1.0	0.9	0.6	2.3	4.4	0.8	0.8– 1.6	1.1	23
	Phosphorus	0.02	0.02	0.02	0.01	0.04	0.02			
9 Palmer mine (Bg3)	Ash	13.2	40.2	11.8	17.5	21.5	14.0	6.3–16.5	9.2	
Pittsburgh coal	Sulphur	2.1	1.3	0.8	6.5	5.3	1.3	0.8– 3.8	1.5	55
	Phosphorus	0.01	0.03	0.03	0.01	0.07	0.04			
10 Ralph mine (Cf14)	Ash	17.5	11.4	9.0	9.2	15.3	9.9	5.2–12.5	7.6	
Pittsburgh coal	Sulphur	1.9	1.2	0.9	2.9	4.3	1.0	0.1– 2.8	1.1	34
	Phosphorus	0.07	0.05	0.01	0.01	0.03	0.02			

Table No. 3 Sectional and composite analyses showing ash, sulphur and phosphorus in the Pittsburgh, Redstone and Sewickley coals in various mines in Fayette County—Continued

[Analyst—H. C. Frick Coke Co.]

Mine and bed		A	B	C	D	E	Composite	Range	Average	Number[2] of samples
LUZERNE TOWNSHIP										
11 Alicia No. 1 mine (Bd1) Pittsburgh coal	Ash	11.7	9.3	9.2	5.3	4.9	9.0			
	Sulphur	3.8	3.5	2.2	0.9	0.8	2.3			
	Phosphorus	0.07	0.08	0.01	0.01	0.01	0.02			
12 Allison No. 2 mine (Ce12) Pittsburgh coal	Ash	8.5	6.9	8.0	12.7	13.0	8.3			
	Sulphur	2.4	2.2	1.1	2.3	2.4	1.3			
	Phosphorus	0.09	0.06	0.01	0.01	0.04	0.02			
13 Bridgeport mine (Cd5) Pittsburgh coal	Ash	13.1	9.0	9.5	8.5	15.2	9.9	4.7–13.9	9.1	
	Sulphur	6.0	3.6	2.5	1.5	3.0	2.8	0.1– 4.0	1.9	90
	Phosphorus	0.05	0.04	0.02	0.02	0.05	0.02			
14 Hustead mine (Ac3) Pittsburgh coal	Ash	19.5		7.7		8.2			10.3	
	Sulphur	4.8		1.6		1.4			2.3	9
	Phosphorus	0.01		0.01		0.01			0.01	
15 Isabella mine (Bf5) Pittsburgh coal	Ash	10.4		10.5		6.5	10.2			
	Sulphur	2.9		2.0		1.1	2.0			
	Phosphorus	0.06		0.01		0.02	0.02			
16 LaBelle mine (Ad3) Pittsburgh coal	Ash	19.0		7.9		14.5	9.4		10.5	
	Sulphur	4.3		1.7		2.3	2.0		2.0	11
	Phosphorus	0.01		0.01		0.03	0.02		0.02	
17 Maxwell mine (Ad2) Pittsburgh coal	Ash	21.8	12.8	6.9	9.6	16.9	9.0	7.3–12.5	9.5	
	Sulphur	1.4	1.4	0.8	2.6	3.2	1.1	1.0– 2.6	1.8	20
	Phosphorus	0.01	0.03	0.01	0.01	0.07	0.01			
18 Sharpnack mine (Cc9) Pittsburgh coal	Ash	8.0	6.9	8.4	7.3	16.5	8.6			
	Sulphur	4.1	3.6	2.4	1.6	2.9	2.6			
	Phosphorus	0.02	0.02	0.01	0.02	0.02	0.02			
19 Sarah shaft (Bc18) Pittsburgh coal	Ash	17.4	17.3	6.7	7.8	16.3	8.5			
	Sulphur	4.5	2.9	1.4	2.1	3.9	1.8			
	Phosphorus	0.04	0.01	0.01	0.02	0.07	0.02			
20 Thompson No. 2 mine (Cf5) Pittsburgh coal	Ash	8.8		9.0		13.2	9.4			
	Sulphur	3.4		2.1		3.1	2.2			
	Phosphorus	0.09		0.01		0.03	0.01			
21 Tower Hill No. 2 mine (Ce16) Pittsburgh coal	Ash	9.2	6.9	6.8	5.0	11.3	7.0			
	Sulphur	2.8	2.3	0.9	0.9	2.9	1.2			
	Phosphorus	0.01	0.01	0.01	0.01	0.01	0.01			

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[1] Analyses quoted on "as received" basis.

[2] Number of channel samples of entire bed used to determine the range and average of the mine.

Table No. 3—Continued [Analyst—H. C. Frick Coke Co.]

Mine and bed		A	B	C	D	E	Com-posite	Range	Aver-age	Number[2] of samples
NICHOLSON TOWNSHIP										
22 Donald No. 1 mine (Bi1) Pittsburgh coal	Ash	11.8	11.6	7.7	4.5	6.5	8.0			
	Sulphur	4.6	3.2	1.6	1.6	2.2	2.0			
	Phosphorus	0.01	0.01	0.01	0.01	0.01	0.01			
23 Donald No. 2 mine (Bi2) Pittsburgh coal	Ash	12.0		7.9		12.1	8.8			
	Sulphur	4.7		1.7		3.2	2.2			
	Phosphorus	0.01		0.01		0.01	0.01			
24 Donald No. 2 mine (Bi2) Pittsburgh coal	Ash	11.0	11.5	7.8	11.3	9.6	8.5			
	Sulphur	4.5	2.1	2.1	2.8	2.9	2.3			
	Phosphorus	0.01	0.01	0.01	0.02	0.02	0.01			
NORTH UNION TOWNSHIP										
25 Mt. Braddock mine (If4) Pittsburgh coal	Ash	9.6	8.9	7.2	8.6	14.8	7.7			
	Sulphur	2.2	1.2	1.1	1.1	2.4	1.3			
	Phosphorus	0.02	0.01	0.01	0.01	0.03	0.01			
26 Mt. Braddock mine (If4) Pittsburgh coal	Ash	10.1		7.2		9.5	7.4	6.6–12.2	8.2	
	Sulphur	1.7		0.8		1.4	0.9	0.8– 1.8	1.1	7
	Phosphorus	0.07		0.02		0.01	0.02			
PERRY TOWNSHIP										
27 Washington No. 1 mine (Fc9) Pittsburgh coal	Ash	8.8	6.5	7.4	6.9	11.7	7.6			
	Sulphur	2.7	1.8	1.1	1.1	1.8	1.3			
	Phosphorus									
REDSTONE TOWNSHIP										
28 Colonial No. 3 mine (Ed2) Pittsburgh coal	Ash	10.2	7.9	8.8	14.4	18.2	9.5	6.1–11.2	8.3	
	Sulphur	2.5	1.3	2.1	2.1	6.1	2.2	1.0– 2.7	1.5	46
	Phosphorus						0.01			
29 Republic mine (Ce7) Pittsburgh coal	Ash	8.8	7.9	7.8	14.1	16.6	8.5	7.9– 9.3		
	Sulphur	3.0	2.5	1.4	1.7	4.1	1.6	1.1– 1.7		3
	Phosphorus	0.03	0.01	0.02	0.04	0.06	0.02	0.02– 0.02		
30 Tower Hill No. 1 mine (Cf1) Pittsburgh coal	Ash	7.9		8.9		11.9	9.0			
	Sulphur	2.5		2.0		3.5	2.2			
	Phosphorus	0.01		0.01		0.03	0.01			
SOUTH UNION TOWNSHIP										
31 Continental No. 1 shaft (Gg3) Sewickley coal	Ash	20.2	6.0	18.8	21.5	18.4	17.0			
	Sulphur	6.1	2.8	4.5	5.0	5.2	4.7			
	Phosphorus	0.01	0.01	0.01	0.01	0.01	0.01			
UPPER TYRONE TOWNSHIP										
32 Fox bank (Ka) East Huntingdon Township, Westmoreland County Redstone coal	Ash	15.0	6.0	12.0	8.9	16.4	11.8			
	Sulphur	3.7	2.0	2.2	2.2	5.3	2.7			
	Phosphorus	0.01	0.01	0.01	0.01	0.02	0.02			

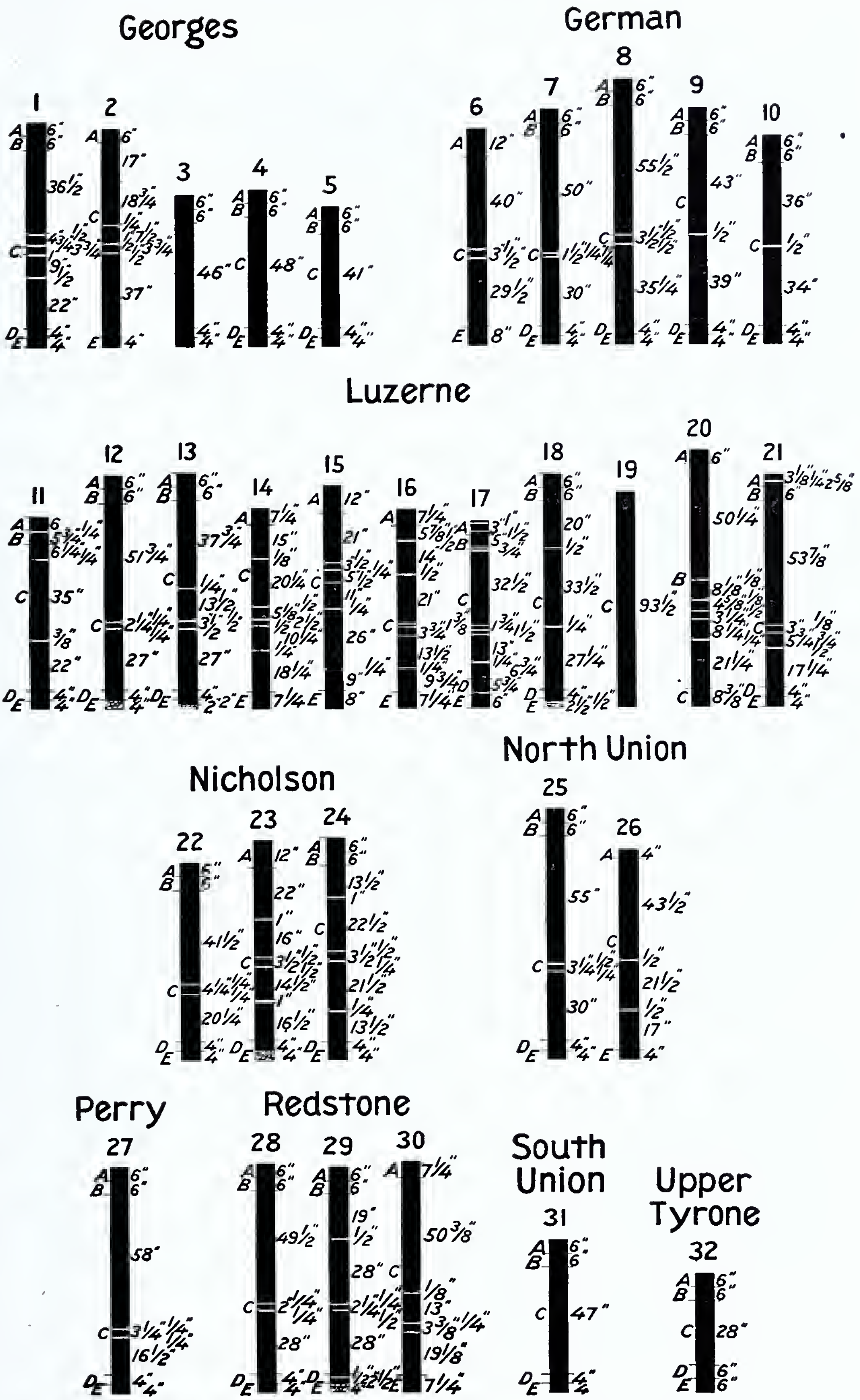

Figure 132. Sections of coal beds whose analyses are given in Table 3.

Explanation of Table No. 4. Table No. 4 lists the range and average of ash, sulphur, and phosphorus determinations of several channel samples of the entire bed for a particular mine or field. The analyses of this table are all of the Pittsburgh coal.

*Table No. 4 Analyses showing range and average of ash, sulphur and phosphorus in the Pittsburgh coal from various mines and fields in Fayette County**

[Analyst—H. C. Frick Coke Co.]

	Mine and field		Minimum	Maximum	Average	Number[1] of samples
	DUNBAR TOWNSHIP					
1	Juniata mine (He8)	Ash	6.1	9.5	7.5	16
		Sulphur	0.9	1.7	1.3	
2	Leisenring No. 1 mine (Ie1)	Ash	5.8	18.8	7.9	65
		Sulphur	0.7	2.5	1.3	
3	Leisenring No. 3 mine (Ie2)	Ash	5.7	8.9	7.2	17
		Sulphur	0.9	1.4	1.2	
4	Leisenring field (He, Ie)	Ash	5.2	18.8	7.7	137
		Sulphur	0.7	3.2	1.2	
	FRANKLIN TOWNSHIP					
5	Colonial No. 1 mine (Fd4)	Ash	5.5	10.2	8.1	36
		Sulphur	1.0	2.3	1.5	
	GEORGES TOWNSHIP					
6	Collier mine (Fh3)	Ash	5.3	10.8	7.0	44
		Sulphur	0.7	2.1	1.1	
7	Fairchance field (Fi)	Ash	3.0	14.4	7.4	275
		Sulphur	0.4	3.5	1.2	
8	Oliphant mine (Gh11)	Ash	5.2	9.5	6.9	26
		Sulphur	0.4	2.5	1.1	
9	Shoaf field (Eh)	Ash	5.5	14.4	7.9	39
		Sulphur	0.5	1.6	1.1	
10	Wynn mine (Fh12)	Ash	5.3	10.5	8.0	36
		Sulphur	0.4	2.9	1.3	
	GERMAN TOWNSHIP					
11	Edenborn mine (Cg15)	Ash	6.4	10.6	7.9	22
		Sulphur	0.9	2.6	1.3	
12	Edenborn-Gates field (Cg)	Ash	5.8	12.4	7.9	89
		Sulphur	0.8	2.8	1.3	
13	Edenborn-Gates-Ronco-Leckrone field (Cg, Ch, Dh)	Ash	5.3	12.4	8.0	140
		Sulphur	0.8	2.8	1.3	
14	Edenborn mine (Cg15)	Ash	5.9	11.9	7.6	23
		Sulphur	0.6	1.4	0.9	
15	Leckrone-Ronco field (Ch, Dh)	Ash	5.3	11.1	8.2	51
		Sulphur	0.8	2.1	1.3	
16	Lambert mine (Dg1)	Ash	4.9	11.6	7.7	41
		Sulphur	0.6	1.7	1.1	
17	Palmer field (Bf, Bg, Cf, Cg)	Ash	4.3	16.5	8.0	214
		Sulphur	0.6	4.8	1.3	
	JEFFERSON TOWNSHIP					
18	Colonial No. 4 mine (Ed23)	Ash	5.3	10.8	8.1	73
		Sulphur	0.9	2.8	1.5	

*Table No. 4 Analyses showing range and average of ash, sulphur and phosphorus in the Pittsburgh coal from various mines and fields in Fayette County**—Continued

[Analyst—H. C. Frick Coke Co.]

	Mine and field		Minimum	Maximum	Average	Number[1] of samples
	LUZERNE TOWNSHIP					
19	Maxwell-Bridgeport fields (Ad, Ae, Cd, Cf)	Ash Sulphur	4.7 0.8	13.9 4.0	9.3 1.8	110
	REDSTONE TOWNSHIP					
20	Colonial field (Dd, Df, Ed, Ef)	Ash Sulphur	5.3 0.9	11.2 2.8	8.1 1.5	155
21	Filbert mine (Df5)	Ash Sulphur	4.3 0.8	11.8 3.6	7.9 1.5	26
	MENALLEN TOWNSHIP					
22	Dearth mine (Ef11)	Ash Sulphur	6.4 0.7	11.0 4.8	8.1 1.5	35
	NORTH UNION TOWNSHIP					
23	Crossland mine (Hg13)	Ash Sulphur	7.0 0.8	16.4 5.8	8.9 1.4	25
24	Phillips mine (Gf4)	Ash Sulphur	5.3 1.1	9.5 3.6	7.6 1.6	32
25	Youngstown mine (If9)	Ash Sulphur	6.1 0.7	10.6 1.3	7.8 1.0	21
	SOUTH UNION TOWNSHIP					
26	Continental No. 1 mine (Gg3)	Ash Sulphur	4.5 0.6	11.7 1.6	7.7 0.9	127
27	Continental field (Fg, Gg)	Ash Sulphur	4.0 0.6	16.4 5.8	7.9 1.2	239
28	Leith mine (Cg6)	Ash Sulphur	4.0 0.8	10.9 2.2	7.3 1.2	34
29	Redstone mine (Gh4)	Ash Sulphur	6.3 0.7	10.6 1.9	7.9 1.2	24

* Analyses quoted on "as received" basis.

[1] Number of channel samples of entire bed used.

Explanation of Table No. 5. This table gives analyses as determined by the United States Bureau of Mines of delivered coal and tipple samples of various coal mines and beds of Fayette County. The table headings are self-explanatory.

Table No. 5 Analyses of delivered coal and tipple samples of the various coal beds of Fayette County

[Analyst—United States Bureau of Mines]

Mine and bed	Size of coal	Air-drying loss	Proximate analysis					As received		Softening[1] temperature °F.	Approximate tons delivered	Number of analyses averaged	Bureau of Mines analysis number	Sampled at
			As received moisture	Dry coal				Br. ther. units	Calories					
				Volatile matter	Fixed carbon	Ash	Sulphur							
BROWNSVILLE TOWNSHIP														
Pike mine (Cd2) Pittsburgh coal	Nut and slack		3.6	32.2	56.6	11.2	1.4	12,940	7,189		1,619	24		Delivery
DUNBAR TOWNSHIP														
Leisenring No. 1 mine (Ie1) Pittsburgh coal	Run of mine		5.1	29.4	61.4	9.2	0.9	13,370	7,428			1	4,609	Delivery
GEORGES TOWNSHIP														
Doris mine (Fh) Sewickley coal	Run of mine	0.7	1.8	31.9	57.2	10.9	2.6	13,370	7,428	2,560			A95,921	Tipple
GERMAN TOWNSHIP														
Puritan No. 6 mine (Dg9) Pittsburgh coal	Run of mine	0.8	1.9	34.3	58.7	7.0	1.0	13,990	7,772	2,804			A95,744	Tipple
JEFFERSON TOWNSHIP														
Braznell mine (Dd) (Sumner mine?) Pittsburgh coal?	Screenings		5.4	30.8	58.3	10.9	1.7	12,670	7,039		8,018	35		Delivery
Fayette mine (Ec2) Pittsburgh coal	Run of mine	0.6	1.5	34.5	57.9	7.6	1.0	13,930	7,739	2,780			A95,742	Tipple
LUZERNE TOWNSHIP														
Hustead mine (Ae3) Pittsburgh coal	Run of mine		3.2	32.8	54.3	12.9	2.0	12,880	7,156			1	2,161	Delivery
Melrose mine (Be1) Pittsburgh coal	+ 5″ lump	0.9	1.9	35.9	52.8	11.3	2.4	13,280	7,378	2,520			A83,956	Tipple
	2″ x 5″ egg	1.0	2.0	36.0	54.6	9.4	1.9	13,580	7,544	2,550			A83,957	Tipple
	2″ x 2″ nut	1.0	2.1	35.0	54.6	10.4	1.8	13,360	7,422	2,560			A83,958	Tipple
	— 2″ nut and slack	1.9	3.0	33.6	54.9	11.5	2.0	13,000	7,222	2,300			A83,959	Tipple
	Run of mine	0.8	1.8	35.2	54.5	10.3	2.1	13,430	7,461	2,400			A83,960	Tipple
MENALLEN TOWNSHIP														
Lincoln mine (Fe8) Pittsburgh coal	Run of mine	0.6	1.7	33.8	58.2	8.0	1.1	13,870	7,706	2,850		1	A95,922	Tipple
NICHOLSON TOWNSHIP														
Donald No. 2 mine (Bi2) Pittsburgh coal	Run of mine	0.8	1.8	34.3	57.7	8.0	2.1	13,790	7,661	2,390		1	A95,924	Tipple

Table No. 5 Analyses of delivered coal and tipple samples of the various coal beds of Fayette County—Continued

[Analyst—United States Bureau of Mines]

Mine and bed	Size of coal	Air-drying loss	Proximate analysis					As received		Softening[1] temperature °F.	Approximate tons delivered	Number of analyses averaged	Bureau of Mines analysis number	Sampled at
				Dry coal										
			As received moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Br. ther. units	Calories					
NORTH UNION TOWNSHIP														
Oliver No. 2 mine (Gg1) Pittsburgh coal	Run of mine	1.2	2.1	31.6	61.1	7.3	0.9	14,100	7,833	2,870		1	A95,590	Tipple
PERRY TOWNSHIP														
Washington No. 1 mine (Fe9) Pittsburgh coal	Run of mine	2.1	2.8	33.0	59.2	7.9	1.2	13,755	7,642	2,410		2		Tipple
REDSTONE TOWNSHIP														
Allison No. 1 mine (De3) Pittsburgh coal	Run of mine	0.6	1.7	33.9	57.3	8.8	1.3	13,770	7,650	2,680		1	A95,923	Tipple
Albright farm bank (Dd8) Waynesburg coal	Run of mine	1.2	2.2	34.5	49.4	16.1	2.7	12,400	6,889	2,570		1	A95,405	Tipple
SALTLICK TOWNSHIP														
All Lower Kittanning coal														
Big Chief mine (Od3)	Run of mine		3.2	24.0	64.3	11.7	2.4	13,220	7,344		900	13		Delivery
Big Chief mine (Od3)	Run of mine	1.2	1.8	23.8	66.7	9.5	2.6	13,855	7,697	2,480		4		Delivery
Indian Creek No. 1 mine (Od5)	Run of mine		3.0	24.3	64.2	11.5	2.4	13,340	7,411		650	8		Delivery
Indian Creek No. 1 mine (Od5)	Run of mine	2.9	3.3	24.2	64.2	8.3	2.0	13,690	7,606	2,350			98,568	Tipple
Indian Creek No. 1 mine (Od5)	Run of mine	1.9	2.3	24.1	62.4	11.2	2.4	13,420	7,456	2,490			A1,191	Tipple
Indian Creek No. 1 mine (Od5)	Run of mine	1.5	2.0	25.2	65.3	9.5	2.8	13,840	7,689	2,200		1	A55,051	Tipple
Kimmel mine (Oe9)	Run of mine		3.7	23.9	64.7	11.4	2.8	13,230	7,350		250	4		Delivery
Melcroft mine (Oe6)	Run of mine		2.2	25.7	63.5	10.8	2.2	13,540	7,522		850	13		Delivery
Melcroft mine (Oe6)	Run of mine		2.7	25.0	64.3	10.7	2.5	13,440	7,467		400	8		Delivery
Melcroft mine (Oe6)	Run of mine	2.4	2.9	24.6	61.3	11.2	2.6	13,220	7,344	2,390			98,546	Tipple
Melcroft mine (Oe6)	Run of mine	1.6	2.0	24.3	63.1	10.6	2.4	13,530	7,517	2,400			A1,121	Tipple
Melcroft mine (Oe6)	Run of mine		0.6	25.7	64.3	9.4	1.8	13,990	7,772	2,470			A55,006	Tipple

Table No. 5 Analyses of delivered coal and tipple samples of the various coal beds of Fayette County—Continued

[Analyst—United States Bureau of Mines]

Mine and bed	Size of coal	Air-drying loss	Proximate analysis					As received		Softening[1] temperature °F.	Approximate tons delivered	Number of analyses averaged	Bureau of Mines analysis number	Sampled at
			As received moisture	Dry coal				Br. ther. units	Calories					
				Volatile matter	Fixed carbon	Ash	Sulphur							
SPRINGFIELD TOWNSHIP														
Campbell mine (Nc)(Now Silcox mine) Lower Kittanning coal	Run of mine	2.0	2.6	25.3	63.3	11.4	2.8	13,340	7,411		250	4		Delivery
Campbell No. 2 mine (Now Silcox mine) Lower Kittanning coal	Run of mine	1.6	2.1	25.1	60.1	14.8	2.8	12,830	7,128	2,460			A41,261	Tipple
Silcox mine (Ne)(Formerly Campbell) Lower Kittanning coal	Run of mine	2.0	2.6	26.1	59.3	14.6	3.9	12,810	7,117	2,390			A71,871	Tipple
Indian Creek No. 2 mine (Nc) Lower Kittanning coal	Run of mine	3.0	3.3	25.2	65.1	9.7	1.8	13,560	7,533	2,570			A48,468	Tipple
Indian Creek No. 3 mine (Nd) Lower Kittanning coal	Run of mine	2.6	2.9	25.5	63.8	10.7	2.1	13,420	7,455	2,510			A55,121	Tipple
Indian Creek No. 2 mine Lower Freeport coal	Run of mine		2.2	25.2	60.1	14.7	2.6	12,820	7,122		150	3		Delivery
Indian Creek No. 2 mine Lower Freeport coal	Run of mine	1.3	2.0	24.8	63.2	12.0	2.6	13,300	7,389	2,390			A22,153	Tipple
Indian Creek No. 2 mine Lower Freeport coal	Run of mine	3.9	4.3	25.6	63.3	11.1	2.6	13,180	7,322	2,390			A33,046	Tipple
Indian Creek No. 2 mine Lower Freeport coal	Run of mine	1.2	1.9	25.8	65.2	9.0	2.3	13,870	7,705	2,440			A55,095	Tipple
SPRINGHILL TOWNSHIP														
Eagle mine (DK8) Pittsburgh coal	Run of mine	1.2	1.8	33.8	55.5	10.7	3.6	13,450	7,472	2,360			A95,743	Tipple
STEWART TOWNSHIP														
Bailey mine (Mh) Brookville-Clarion and Lower Kittanning coals	Run of mine		2.8	23.3	58.6	18.1	3.9	12,170	6,761		50	1		Delivery
Jim Run mine (Mg9) Lower Kittanning coal	Run of mine		3.8	22.9	56.4	20.7	4.2	11,540	6,411		50	1		Delivery

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[1] Temperature at which the cone of coal ash has fused down to a spherical lump when heated in a slightly reducing atmosphere.

Miscellaneous Tables: Coal washing. Cleaning and preparation of the mined coal has been practiced little in Fayette County because of the purity of the chief source of the coal, the Pittsburgh bed. However, the Pittsburgh coal in some of the mines of the Klondike district requires either selective mining, which means increased costs and incomplete recovery, or cleaning of the coal in order to manufacture satisfactory metallurgical coke. The first coal-washing plant was located ½ mile east of Dunbar and was operated by the Dunbar Corporation for the by-product coke ovens there. Upper Freeport run-of-mine coal from Furnace Nos. 1 and 2 mines was treated in this plant, which operated until 1924, when the coke ovens and plant were abandoned. Sample No. 31 in Table No. 2 gives the bed section and analysis of the coal treated. The following table represents the only available information on this plant.

Analyses of washed coal, refuse, and coke from the Upper Freeport bed

	V. M.	F. C.	Ash	Sul.	Phos.
Washed run of mine coal	28.9	62.7	8.4	1.5	0.01
Refuse from washed coal	16.4	27.3	56.3	5.9	0.02
Coke made from washed coal	0.8	89.0	10.2	1.1	0.02
Average of 6 analyses of washed coal			6.8	1.4	
Average of 6 samples of coke made from washed coal			11.2	1.1	

An air-cleaning plant had been operated by the Buckeye Coal Company on the run-of-mine Pittsburgh coal from the Brier Hill mine. Unfortunately, no information is available on this plant, which is temporarily abandoned.

The Pittsburgh Coal Company operated a coal-washing plant on the coal from Banning Nos. 1 and 2 mines in the Pittsburgh coal. No information is available.

The Clairton Coke Works of the Carnegie Steel Company operates a coal-washing plant at Clairton, Penna., in which nearly all of the coal treated is derived from the H. C. Frick Coke Company's mines on the Pittsburgh coal in Fayette County. Mr. H. W. Sayler, chief chemist of the Clairton Coke Works, gives an excellent detailed description of this plant in "Coal Age," vol. 38, no. 6; June, 1933, issue. The following tables are reproduced from Mr. Sayler's discussion:

Source and analyses of coal treated at the Clairton Coke Works.

Mine	Tons of coal carbonized per day	Method of delivery	Average V. M.	Average ash	Average sulphur
Colonial	10,190	Barge	32.95	8.84	1.25
Ronco	3,906	Barge	32.93	7.88	1.07
Palmer	8,665	Barge	32.90	8.10	1.04
Gates	4,209	Barge	32.91	8.26	0.97
Bridgeport ...	2,272	Barge	33.60	9.58	1.70
Calumet	1,045	Rail	28.78	9.00	1.33

The mines listed, with the exception of the Calumet mine, are in the Pittsburgh coal in the Klondike district of Fayette County. Calumet mine is in the Pittsburgh coal in the Latrobe syncline of Westmoreland County.

Partial analyses of sized raw and washed coal

Sieve	RAW COAL			WASHED COAL		
	Percent	Ash	Sulphur	Percent	Ash	Sulphur
Plus 3″ square	4.12	9.05	0.90	3.64	7.46	0.89
3 x 2″ square	8.66	8.58	0.99	7.95	7.85	0.87
2 x 1″ square	23.04	9.49	1.06	19.58	7.58	0.91
1 x ⅜″ round	27.10	9.10	1.07	31.70	7.69	0.97
⅜″ x 20 mesh	28.84	7.60	1.09	25.49	6.70	0.95
20 x 28 mesh	1.71	6.81	1.13	1.96	5.30	0.95
28 x 48 mesh	3.10	7.06	1.18	3.58	5.28	0.95
48 x 100 mesh	1.79	8.09	1.62	2.32	7.89	1.47
100 x 200 mesh	0.72	9.41	2.35	0.81	9.92	2.33
Minus 200 mesh	0.92	11.04	1.95	3.03	12.30	1.86

It is to be noted that some reduction of the ash and sulphur is effected on all sizes down to 100 mesh.

The following table shows the average comparative analyses and yields from raw and washed coal:

Coke yielded by raw and washed coal

	RAW COAL			WASHED COAL		
	Sulphur	Ash	Yield (percent)	Sulphur	Ash	Yield (percent)
Metallurgical coke (plus 1¼″)	0.92	11.50	60.00	0.80	10.31	62.00
Domestic coke (1¼ x ¾″)	0.92	15.00	4.00	0.80	10.50	3.50
Coke dust (¾″ x 0)	1.00	19.00	6.00	0.83	12.83	4.00

The following table lists the analyses and float and sink data of the products of the coal-washing plant for the month of November, 1932. For additional float and sink tests and other detailed information on the Clairton Coke Works coal-washing plant, the reader is referred to Mr. Sayler's article.

Analyses and float and sink test data of products from coal washing plant

November, 1932

ANALYSES

	Moisture, percent	Sulphur, percent	Ash, percent	Volatile matter, percent	Fixed carbon, percent	Tons produced at indicated moistrue
Raw coal	4.47	1.11	8.62	32.17	59.21	172,468
Washed coal	6.11	.99	7.33	32.92	59.75	171,619
Refuse (over-all)	6.79	5.60	68.20	----	----	3,889
Filter product	24.47	1.61	9.24	----	----	------
Centrifugal dryer	7.79	.94	6.33	----	----	------

FLOAT AND SINK TEST DATA

			Float 1.40			Sink 1.40 Float 1.55			Total float 1.55			Sink 1.55			Head	
	Percent (dry)	Sieve, percent	Percent	Ash, percent	Sulphur, percent	Percent	Ash, percent	Sulphur, percent	Percent	Ash, percent	Sulphur, percent	Percent	Ash, percent	Sulphur, percent	Ash, percent	Sulphur, percent
Raw coal																
Plus ⅜ in.	----	65.50	96.36	7.30	.93	1.34	23.15	2.14	97.70	7.51	.95	2.30	63.20	4.15	8.79	1.03
⅜ x 20 mesh	----	26.22	95.81	5.95	.90	1.50	21.87	2.35	97.31	6.20	.92	2.69	63.57	5.96	7.74	1.06
Minus 20 mesh	----	8.28	92.08	5.60	1.05	3.77	16.62	1.68	95.85	6.03	1.07	4.15	56.72	12.49	8.13	1.55
Over-all	----	-----	95.86	6.81	.94	1.58	21.55	2.10	97.44	7.05	.95	2.56	62.43	6.06	8.47	1.10
Washed coal																
Plus ⅜ in.	----	64.62	98.20	7.16	.91	1.35	22.56	2.23	99.55	7.37	.94	.45	41.72	2.45	7.52	.95
⅜ x 20 mesh	----	23.21	97.65	6.12	.91	1.72	21.90	2.21	99.37	6.39	.92	.63	40.62	3.89	6.60	.94
Minus 20 mesh	----	12.17	93.40	5.72	1.02	3.89	17.94	1.95	97.29	6.21	1.06	2.71	50.85	14.15	7.42	1.41
Over-all	97.8	-----	97.49	6.75	.93	1.74	21.15	2.15	99.23	7.00	.95	.77	45.44	7.76	7.29	1.00
Coarse-coal plant refuse																
Over-all	1.2	See *Note	.98	10.73	1.42	1.15	27.53	2.04	2.13	19.80	1.75	97.87	70.72	4.35	69.64	4.29
Fine-coal plant refuse																
Plus 20 mesh	----	83.53	4.16	7.62	1.04	1.45	27.07	2.72	5.61	12.65	1.47	94.39	70.62	6.28	67.37	6.01
Minus 20 mesh	----	16.47	9.35	10.90	1.50	2.77	20.05	2.53	12.12	12.99	1.73	87.88	72.60	15.57	65.38	13.89
Over-all	1.0	-----	5.01	8.62	1.18	1.67	25.13	2.68	6.68	12.75	1.55	93.32	70.93	7.72	67.04	7.31

EFFICIENCY

	3 in. x 20 mesh, percent	3 in. x 0, percent
Qualitative	79.67	70.70
Quantitative	99.92	99.90

* Note: Sieve test coarse coal plant refuse:

Plus ⅜ in.	91.99
⅜ x 20 mesh	6.75
Minus 20 mesh	1.26

Average tons per hour feed
703

All sieve tests were made on round-hole screens except refuse samples, which were made on square-hole screens.

Mr. Sayler summarizes the chief benefits derived from the washing of coal for coking purposes at the Clairton plant as follows:

1. Reduction of the ash and sulphur in the coke produced.
2. A 10 to 15 percent improvement in the physical qualities of the metallurgical coke produced as determined by the tumbler barrel test.
3. Decreased yields of small size coke with a corresponding increase of metallurgical coke.
4. A 20 percent reduction of hydrogen sulphide content in the coke-oven gas.
5. Increased yields of by-products comparable with the increased percentage of volatile matter in the washed coal.
6. Increased porosity of the coke.
7. Increased production at the mines due to removal of more top and bottom coal.
8. Improvements in blast-furnace operation due to improved quality of metallurgical coke.

The following tables are the results of tests performed at the United States fuel-testing plant located at St. Louis, Missouri, in 1905, on Pittsburgh coal from the Hustead mine, East Millsboro. For descriptions of the procedure followed, the reader is referred to United States Geological Survey Bulletin No. 290, from which these tables are reproduced. The test numbers used here are the same as those used in that bulletin.

Run-of-mine coal was used in the washing, coking, steaming and producer-gas tests. Two face samples were taken for chemical analysis. The coking tests were performed in two standard beehive ovens.

Chemical analyses of coal from the Hustead mine

		Mine samples		Car samples	
	Laboratory number	1968	1970	2161	2176
	Air-drying loss	2.90	1.50	2.00	2.40
Proximate	Moisture	4.08	2.81	3.24	3.46
	Volatile matter	32.44	33.88	31.78	31.80
	Fixed carbon	53.98	54.68	52.46	51.74
	Ash	9.50	8.63	12.52	13.00
Ultimate	Sulphur	1.64	2.00	1.94	1.95
	Hydrogen			4.80	
	Carbon			71.41	
	Nitrogen			1.24	1.20
	Oxygen			8.09	
	Calorific value determined:				
	Calories	7,371		7,155	
	British thermal units	13,268		12,879	

Steaming tests on coal from the Hustead mine

Test 217	Test 218
Size as shipped, run of mine. Size as used, over 1 inch, 35.4 percent; ½ inch to 1 inch, 21.8 percent; ¼ inch to ½ inch, 15 percent; under ¼ inch, 27.8 percent. Duration of test, 9.9 hours. Kind of grate, plain.	Size as shipped, run of mine. Size as used, over 1 inch, 26.4 percent; ½ inch to 1 inch, 22.5 percent; ¼ inch to ½ inch, 16.6 percent; under ¼ inch, 34.5 percent. Duration of test, 9.95 hours. Kind of grate, plain.

Miscellaneous Items

		Test 217	Test 218
Heating value of coal	B. t. u. per pound dry coal	13,405	13,271
Force of draft:			
Under stack damper	inch water	.46	.49
Above fire	do	.13	.17
Furnace temperature	°F.	2,425	2,251
Dry coal used per square foot of grate surface per hour	pounds	19.26	16.65
Equivalent water evaporated per square foot of water-heating surface per hour	pounds	3.46	3.12
Percentage of rated horsepower of boiler developed[d]		97.10	87.40
Water apparently evaporated per pound of coal as fired	pounds	7.46	7.74
Water evaporated from and at 212° F.:			
Per pound of coal as fired	do	8.79	9.11
Per pound of dry coal	do	9.01	9.37
Per pound of combustible	do	10.52	10.94
Efficiency of boiler, including grate	percent	64.91	68.18
Coal as fired:			
Per indicated horsepower hour	pounds	3.22	3.10
Per electrical horsepower hour	do	3.97	3.83
Dry coal:			
Per indicated horsepower hour	do	3.14	3.02
Per electrical horsepower hour	do	3.88	3.72

Analyses

	Test 217	Test 218
Proximate		
Moisture ..	2.44	2.81
Volatile matter ..	32.98	32.80
Fixed carbon	52.48	51.72
Ash	12.10	12.67
Sulphur ...	1.88	2.10

	Test 217	Test 218
Ultimate		
Carbon[1] ...	74.35	73.57
Hydrogen[1] .	4.62	4.58
Oxygen[1] ...	5.41	5.37
Nitrogen[1] ..	1.29	1.28
Sulphur ...	1.93	2.16
Ash	12.40	13.04
	100.00	100.00

[1] Figured from car sample.

Producer-gas tests on coal from the Hustead mine

Test 66

Size as shipped, run of mine. Size as used, over 1 inch, 45 percent; ½ inch to 1 inch, 20 percent; ¼ inch to ½ inch, 15 percent; under ¼ inch, 20 percent. Duration of test, 47 hours.

Average electrical horsepower	195.3
Average B. t. u. gas, per cubic foot	126.6
Total coal fired, pounds ..	13,000

Test 70

Size as shipped, run of mine. Size as used, over 1 inch, 65 percent; ½ inch to 1 inch, 16 percent; ¼ inch to ½ inch, 7 percent; under ¼ inch, 12 percent. Duration of test, 50 hours.

Average electrical horsepower	194.2
Average B. t. u. gas, per cubic foot	146.4
Total coal fired, pounds ..	11,254

Coal consumed in producer (pounds per horsepower per hour)

	Test 66			Test 70		
	Coal as fired	Dry coal	Combustible	Coal as fired	Dry coal	Combustible
Per electrical horsepower:						
Available for outside purposes	1.53	1.50	1.38	1.23	1.19	1.05
Developed at switchboard	1.42	1.39	1.28	1.16	1.13	.99
Per brake horsepower:						
Available for outside purposes	1.30	1.27	1.17	1.04	1.01	.89
Developed at engine	1.20	1.18	1.09	.99	.96	.84
Equivalent used by producer plant						
Per electrical horsepower:						
Available for outside purposes	1.63	1.59	1.47	1.30	1.26	1.11
Developed at switchboard	1.51	1.48	1.36	1.23	1.19	1.05
Per brake horsepower:						
Available for outside purposes	1.38	1.35	1.25	1.10	1.07	.94
Developed at engine	1.28	1.26	1.16	1.04	1.01	.89

Analyses

	Test 66	Test 70
Coal		
Moisture	2.15	2.86
Volatile matter ..	35.01	31.88
Fixed carbon	55.18	53.35
Ash	7.66	11.91
	100.00	100.00
Sulphur	1.00	2.04

	Test 66	Test 70
Gas by volume		
Carbon dioxide (CO_2)	10.0	9.6
Carbon monoxide (CO)	18.5	19.2
Hydrogen (H_2) ...	12.1	11.5
Methane (CH_4) ...	2.4	3.0
Nitrogen (N_2)	57.0	56.7
	100.00	100.00

Washing test

Test 124

Size as shipped, run of mine. Size as used, crushed to 2 inches. Jig used Stewart modified.

Raw coal	pounds	50,000
Washed coal	do	43,300
Refuse	do	6,700

Analyses

	Test 124	
	Raw coal	Washed coal
Moisture	3.24	4.31
Volatile matter	31.78	
Fixed carbon	52.46	
Ash	12.52	7.26
Sulphur	1.94	1.47

Coking tests on coal from the Hustead mine

	Test 32	Test 34	Test 35	Test 38	Test 41
Condition	Raw	Washed	Raw	Washed	Raw
Size as used	Crushed	Crushed	Crushed	Crushed	Crushed
Duration of test (hours)	46	45	88	86	72
Coal charged (pounds)	10,000	10,000	12,000	13,000	12,000
Coke produced (pounds)	7,330	6,905	8,646	8,927	8,743
(percent)	73.30	69.05	72.05	68.67	72.86
Breeze produced (pounds)	315	246	295	373	364
(percent)	3.15	2.46	2.46	2.87	3.03
Total yield (percent)	76.45	71.51	74.51	71.54	75.89

Analyses

	Test 32		Test 34		Test 35	
	Coal	Coke	Coal	Coke	Coal	Coke
Moisture	3.22	0.34	6.58	0.24	3.64	0.48
Volatile matter	31.52	0.71	33.00	0.66	32.01	1.62
Fixed carbon	51.87	82.31	52.96	88.61	51.03	81.20
Ash	13.89	16.64	7.46	10.49	13.32	16.70
Sulphur	2.10	1.59	1.46	1.21	1.93	1.70
Phosphorus		0.024		0.016		0.023

Analyses

	Test 38		Test 41	
	Coal	Coke	Coal	Coke
Moisture	4.21	0.89	2.53	0.27
Volatile matter	33.40	2.26	32.09	1.26
Fixed carbon	55.21	86.77	53.21	82.66
Ash	7.18	10.08	12.17	15.81
Sulphur	1.51	1.24	1.78	1.52
Phosphorus		0.015		0.019

The following tables on Pittsburgh coal from the Leisenring No. 1 mine, 2 miles southwest of Connellsville, are the results of tests performed at the United States fuel-testing plant located at St. Louis, Missouri, in 1906 and 1907. For descriptions of the procedure followed, the reader is referred to United States Geological Survey Bulletin No. 332, from which these tables are reproduced. The test numbers used here are the same as those used in that bulletin. Run-of-mine coal was used in the coking tests, which were performed in two standard beehive coke ovens. Two face samples were taken for chemical analysis.

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Chemical analyses of coal from Leisenring No. 1 mine

	Mine samples		Car sample
Laboratory No.	4,412	4,411	4,609
Air-drying loss	1.80	1.40	4.20
Proximate:			
Moisture	2.82	2.40	5.13
Volatile matter	29.97	29.90	27.87
Fixed carbon	59.84	60.48	58.29
Ash	7.37	7.22	8.71
Sulphur	1.22	.97	.86
Ultimate:			
Hydrogen			4.91
Carbon			73.13
Nitrogen			1.50
Oxygen			10.89
Calorific value determined (as received):			
Calories	7,773		7,525
B. t. u.	13,991		13,365

Coking tests on coal from Leisenring No. 1 mine

	Test 183	Test 187	Test 189	Test 191	Test 192
Size as used	Not crushed	Finely crushed	Not crushed	Through 1-inch screen	Through ¾-inch screen
Duration of test ... hours	70	78	51	47	43
Coal charged ... pounds	15,140	14,360	12,450	11,940	11,500
Coke produced ... do	10,200	9,982	8,457	7,963	7,733
Coke produced ... percent	67.37	69.51	67.93	66.69	67.24
Breeze produced ... pounds	401	326	319	368	339
Breeze produced ... percent	2.65	2.27	2.56	3.08	2.95
Total yield ... do	70.02	71.78	78.49	69.77	70.19

Remarks:—Light gray and silvery; good heavy coke.

Analyses

	Test 183		Test 187		Test 189		Test 191		Test 192	
	Coal	Coke	Coal	Coke	Coal	Coke	Coal	Coke	Coal	Coke
Moisture	5.37	0.71	5.53	0.63	4.05	0.82	4.28	0.33	3.58	0.29
Volatile matter	28.33	.12	27.97	.66	29.26	.21	29.92	.15	28.86	.69
Fixed carbon	59.07	88.24	57.81	87.78	58.29	88.22	58.22	88.54	60.13	88.54
Ash	8.23	10.93	8.69	10.93	8.40	10.75	7.58	10.98	7.43	10.48
Sulphur	.89	.82	.86	.62	.93	.81	.95	.87	.91	.76
Phosphorus		.02		.01		.01		.01		.01

The following table lists the physical properties of the beehive coke produced in the coking tests as given in the immediately preceding tables. These physical properties are listed in the United States Geological Survey Bulletin No. 336 and the tests were performed at the United States fuel-testing plant located at St. Louis, Missouri, in 1905 to 1907.

Physical properties of coke

Test No.	Mine	Specific gravity		Pounds per cubic foot		Percentage by volume		6-foot drop test; percentage over 2-inch mesh			
		Real	Apparent	Dry	As received (wet)	Coke	Cells	1	2	3	4
32	Hustead	1.96	1.09	67.74	95.17	56.0	44.0	95.0	91.5	88.0	84.5
34	Hustead	1.92	1.05	65.34	93.42	55.0	45.0	91.0	84.5	80.5	75.5
35	Hustead	1.91	1.11	68.88	95.10	58.0	42.0				
38	Hustead	1.84	0.97	59.97	89.27	53.0	47.0	97.5	95.5	94.0	92.0
41	Hustead	1.91	1.18	73.42	97.12	62.0	38.0	96.0	91.5	88.0	74.5
183	Leisenring No. 1....	1.94	0.96	59.47	90.68	50.0	50.0				
187	Leisenring No. 1....	1.90	0.92	57.04	89.46	48.0	52.0	96.5	94.0	90.0	87.5
189	Leisenring No. 1....	1.93	0.95	58.75	90.56	49.0	51.0	92.5	84.5	77.5	73.5
191	Leisenring No. 1....	1.97	0.98	60.92	92.13	50.0	50.0	93.5	85.5	79.5	75.0
192	Leisenring No. 1....	1.98	0.96	59.70	91.52	49.0	51.0	91.5	87.0	81.5	77.5

The following table lists the results of by-products tests on run-of-mine Pittsburgh coal from the Leisenring No. 1 mine, 2 miles southwest of Connellsville. The tests were made in an iron retort and for description of the procedure, the reader is referred to United States Bureau of Mines Bulletin No. 1, from which this table is reprinted.

By-product tests on Pittsburgh coal

Laboratory number	3
Number of tests averaged	6
Coke (percent)	71.4
Tar (percent)	11.3
Water (percent)	4.9
Ammonia (pounds of sulphate per ton)	23.8
Carbon dioxide (percent)	0.72
Hydrogen sulphide (percent)	0.25
Gas (cu. ft. per ton[1])	8,140
Composition of gas:[2]	
Illuminants	3.2
Carbon monoxide	5.1
CH_4, C_2H_6, etc.	27.8
Hydrogen	61.0
Nitrogen	2.90
Value of n in $C_nH_{2n} + 2$	1.27
Total volatile products (without moisture)	27.4
Water of constitution	3.7
Inert volatile matter[3]	4.7

Coke Analyses

Only a few analyses of coke manufactured from Fayette County coals are available. Most analyses are of beehive coke, a type which has lost its former prominence in favor of the economically manufactured by-product coke. Other analyses than those listed in the following table are given in the preceding Miscellaneous Tables, where will be found analyses of by-product coke from the Clairton Coke Works and analyses of beehive coke from the Hustead and Leisenring No. 1 mines. In the table below the analysis of typical Connellsville coke (McCreath) was made on a 30-to-50-pound coke sample presumably collected from ovens in the vicinity of Broadford and Connellsville. All the analyses in the table, with the exception of the typical Connellsville coke, are furnished through the courtesy of the H. C. Frick Coke Co.

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[1] Calculated to dry basis at 0°C. and 760 mm. pressure, free of air and carbon dioxide.

[2] Calculated to CO_2 and O free basis.

[3] Sum of CO_2 ammonia and water for constitution.

Analyses of coke manufactured from various Fayette County coals

No.[1]	Mine and coal	V. M.	F. C.	Ash	Sul.	Phos.	Source[2]
	Typical Connellsville coke: Pittsburgh coal	.46	89.6	9.11	.82		Beehive
48	Crawford mine: Pittsburgh coal	.7	88.1	11.2	.08	.02	Laboratory
42	Collier bank: Sewickley coal	1.5	82.3	16.2	3.2	.04	Laboratory
43	Moore bank: Sewickley coal	1.1	81.3	17.6	2.4	.04	Laboratory
46	Hope mine:[3] Sewickley coal	1.1	83.3	15.6	3.2	.01	Beehive
82	Hogsett mine: Sewickley coal	1.2	85.1	13.8	1.5	.01	Laboratory
84	Country bank: Sewickley coal	1.3	83.8	14.9	3.0	.01	Laboratory
31	Furnace Nos. 1 and 2 mines. Washed: Upper Freeport coal	.8	89.0	10.0	1.1	.02	By-product
57	Lauenberger bank: Upper Freeport coal	.7	91.2	8.1	2.1	.01	Laboratory
4	Ringgrove mine:[4] Brookville-Clarion coal:						
	A	1.0	90.0	9.1	2.5	.01	Laboratory
	E	.7	86.3	13.0	2.4	.01	Laboratory

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[1] Number refers to coal analysis and section listed in Coal Analysis, Table No. 2.

[2] Place at which coke was manufactured. If beehive or by-product, coke was manufactured in standard oven of the type.

[3] Sample collected from 7 beehive ovens.

[4] Coke from bed sections A and E. See Coal Analysis, Table No. 2.

COAL RESERVES

At best, any computation of coal reserves in large areas such as townships is an extremely abstract problem. Large errors are apt to enter the calculations, chiefly through lack of sufficient data and the use of small-scale maps. In arriving at the figures on coal resources of Fayette County in the following tables, all available measured sections and information on the attitude and physical characteristics of each bed were used or considered.

Briefly, the method of computation used for determining coal reserves began with the segregation of all information on a particular coal bed in a township. With these data the township was divided into areas in which the coal bed showed the same characteristics and for which an average section of the bed could be determined. The total coal of minable quality for each average bed section was found by adding the thicknesses of the individual coal benches. If a thin bench of coal was separated from the main bed by a thick parting, the thin bench was not included. Bone and bony coal were considered as partings and their thicknesses were not used in the computations. The thickness in inches of minable coal was multiplied by the areas of the township or portion thereof (determined by planimeter from the topographic maps) and by 150 tons. The constant figure, 150 tons per acre-inch of coal bed, was determined by using a specific gravity of 1.37 for the coal. Results of the preceding multiplication for all the areas in the township were totaled to give the quantity of coal originally in place in the township. Mined out or depleted areas shown by mine maps or field observations were placed on the topographic map and the tonnage of coal for the areas was computed by the same method. This figure, titled "Exploited", includes production and all coal lost during mining operations. The difference between the tonnage in place before any mining operations began and the tonnage exploited is the quantity of coal remaining in place at present. This latter figure is multiplied by the percent of mining recovery and the result by the reciprocal of the percent of coal lost during mining to yield a tonnage figure that represents recoverable coal in a particular bed in the township. The percentages of mining recovery and of coal lost during mining are chiefly the opinions of local mining engineers.

In the following tables, all tonnage figures represent total coal of minable quality. The thicknesses are averages of minable coal for a particular bed in a township. They are not to be confused with the total thickness of a coal bed, which includes all coal and partings between the roof and floor.

Coal reserves in Fayette County by townships and beds

Bed	Area (acres)	Original deposit (short tons)	Exploited (short tons)	Recoverable (short tons)	Mining recovery (percent)	Mining loss (percent)	Thickness (inches)
Brownsville Township					Area 1,171 acres		
Waynesburg	150	1,000,000	500,000	350,000	80	15	47
Pittsburgh	998	13,500,000	12,500,000	750,000	90	15	91
Upper Freeport	1,171	9,000,000	----------	4,000,000	50	15	50
Bullskin Township					Area 28,160 acres		
Pittsburgh	1,586	24,000,000	24,000,000	----------	90	15	101
Upper Freeport	10,994	66,000,000	6,000,000	35,500,000	70	15	40
Lower Kittanning	12,680	53,500,000	3,000,000	30,000,000	70	15	28
Connellsville Township					Area 9,000 acres		
Sewickley (Lower)	845	4,000,000	750,000	2,000,000	70	15	30
Redstone	490	2,000,000	----------	1,000,000	60	15	26
Pittsburgh	1,360	22,000,000	21,500,000	350,000	90	15	107
Upper Freeport	4,083	29,500,000	4,000,000	15,000,000	70	15	48
Lower Kittanning	4,894	25,000,000	2,500,000	13,500,000	70	15	34

Coal reserves in Fayette County by townships and beds—Continued

Bed	Area (acres)	Original deposit (short tons)	Exploited (short tons)	Recoverable (short tons)	Mining recovery (percent)	Mining loss (percent)	Thickness (inches)
Dunbar Township					Area 42,112 acres		
Waynesburg	7,907	35,500,000	1,000,000	22,000,000	75	15	30
Sewickley (Lower)	5,372	26,500,000	2,500,000	15,000,000	75	15	33
Redstone	6,598	37,500,000	1,000,000	18,500,000	60	15	38
Pittsburgh	14,947	244,500,000	201,500,000	33,000,000	90	15	109
Upper Freeport	19,398	134,000,000	14,000,000	71,500,000	70	15	46
Lower Kittanning	22,910	110,000,000	7,000,000	61,500,000	70	15	32
Franklin Township					Area 19,392 acres		
Pittsburgh	4,949	73,500,000	57,500,000	12,000,000	90	15	99
Upper Freeport	18,310	123,500,000	3,500,000	71,500,000	70	15	45
Lower Kittanning	18,425	96,500,000	5,500,000	54,000,000	70	15	35
Georges Township					Area 31,616 acres		
Waynesburg	898	4,000,000	500,000	2,000,000	75	15	30
Sewickley	7,235	63,000,000	39,500,000	16,000,000	80	15	58
Pittsburgh	10,403	140,500,000	89,000,000	39,500,000	90	15	90
Upper Freeport	22,295	207,500,000	3,000,000	121,500,000	70	15	62
Brookville-Clarion	23,660	163,500,000	2,500,000	96,000,000	70	15	46
German Township					Area 22,467 acres		
Waynesburg	8,127	59,500,000	22,000,000	30,000,000	75	15	49
Sewickley	4,500	43,000,000	9,500,000	23,000,000	80	15	64
Pittsburgh	16,528	250,500,000	181,500,000	53,000,000	90	15	101
Upper Freeport	22,467	108,000,000	--------------	46,000,000	50	15	32
Henry Clay Township					Area 37,376 acres		
Upper Freeport	13,300	92,000,000	5,500,000	59,000,000	80	15	46
Upper Kittanning	17,500	76,000,000	1,000,000	44,500,000	70	15	29
Lower Kittanning	21,700	107,500,000	1,000,000	63,500,000	70	15	33
Brookville-Clarion	23,500	169,000,000	3,500,000	98,500,000	70	15	48
Jefferson Township					Area 13,478 acres		
Waynesburg	2,324	14,500,000	1,000,000	8,500,000	75	15	42
Redstone	1,500	8,500,000	2,000,000	4,000,000	75	15	38
Pittsburgh	12,848	171,500,000	134,500,000	28,500,000	90	15	89
Upper Freeport	13,478	129,500,000	--------------	55,000,000	50	15	64
Lower Kittanning	13,478	85,000,000	--------------	36,000,000	50	15	42

Coal reserves in Fayette County by townships and beds—Continued

Red	Area (acres)	Original deposit (short tons)	Exploited (short tons)	Recoverable (short tons)	Mining recovery (percent)	Mining loss (percent)	Thickness (percent)
Lower Tyrone Township							Area 10,560 acres
Pittsburgh	1,128	17,000,000	16,500,000	250,000	90	15	100
Upper Freeport	9,587	62,000,000	3,500,000	35,000,000	70	15	43
Lower Kittanning	10,226	52,000,000	1,500,000	30,000,000	70	15	34
Luzerne Township							Area 20,000 acres
Waynesburg	9,461	64,000,000	20,500,000	27,500,000	75	15	45
Pittsburgh	19,303	260,500,000	131,500,000	98,500,000	90	15	90
Upper Freeport	20,000	180,000,000	--------------	76,500,000	50	15	60
Menallen Township							Area 14,150 acres
Waynesburg	1,259	8,500,000	3,500,000	3,000,000	75	15	46
Pittsburgh	6,092	92,500,000	77,000,000	12,000,000	90	15	101
Upper Freeport	14,150	76,500,000	--------------	32,500,000	50	15	36
Nicholson Township							Area 14,022 acres
Sewickley	2,800	24,500,000	8,500,000	11,000,000	80	15	58
Pittsburgh	4,900	69,000,000	61,000,000	6,000,000	90	15	94
Upper Freeport	14,022	69,500,000	--------------	29,500,000	50	15	33
North Union Township (includes Uniontown)							Area 21,696 acres
Waynesburg	7,590	34,000,000	1,000,000	21,000,000	75	15	30
Sewickley	8,500	75,000,000	17,500,000	39,000,000	80	15	59
Redstone	8,000	43,000,000	--------------	22,000,000	60	15	36
Pittsburgh	12,082	183,000,000	147,500,000	27,000,000	90	15	101
Upper Freeport	17,536	100,000,000	1,000,000	59,000,000	70	15	38
Lower Kittanning	18,029	70,500,000	1,000,000	41,500,000	70	15	26
Brookville-Clarion	18,317	118,000,000	1,000,000	69,500,000	70	15	43
Perry Township							Area 14,208 acres
Sewickley	3,875	20,000,000	1,500,000	12,000,000	75	15	34
Redstone	4,307	22,000,000	500,000	11,500,000	60	15	36
Pittsburgh	5,253	74,000,000	68,500,000	4,000,000	90	15	94
Upper Freeport	13,420	86,500,000	3,000,000	49,500,000	70	15	43
Lower Kittanning	13,741	70,000,000	1,000,000	41,000,000	70	15	34
Redstone Township							Area 14,643 acres
Waynesburg	12,157	87,500,000	29,000,000	37,500,000	75	15	48
Pittsburgh	14,485	200,000,000	108,500,000	70,000,000	90	15	92
Upper Freeport	14,643	96,500,000	--------------	41,000,000	50	15	44
Saltlick Township							Area 25,984 acres
Upper Freeport	7,820	42,000,000	6,000,000	24,500,000	80	15	36
Lower Kittanning	15,100	95,000,000	50,000,000	30,500,000	80	15	42

Coal reserves in Fayette County by townships and beds—Continued

Bed	Area (acres)	Original deposit (short tons)	Exploited (short tons)	Recoverable (short tons)	Mining recovery (percent)	Mining loss (percent)	Thickness (inches)
South Union Township							Area 11,072 acres
Waynesburg	1,649	7,500,000	2,000,000	3,500,000	75	15	30
Sewickley	3,816	34,500,000	21,500,000	9,000,000	80	15	60
Redstone	4,350	22,500,000	1,000,000	11,000,000	60	15	34
Pittsburgh	5,103	76,500,000	56,000,000	15,500,000	90	15	100
Upper Freeport	6,458	41,500,000	1,000,000	24,000,000	70	15	43
Lower Kittanning	6,633	26,000,000	500,000	15,000,000	70	15	26
Brookville-Clarion	6,768	43,500,000	1,000,000	25,500,000	70	15	43
Springfield Township							Area 41,600 acres
Upper Freeport	10,200	49,000,000	7,000,000	28,500,000	80	15	32
Lower Kittanning	17,400	96,500,000	10,000,000	59,000,000	80	15	37
Brookville-Clarion	21,200	95,500,000	4,500,000	54,000,000	70	15	30
Springhill Township							Area 20,608 acres
Sewickley	3,000	23,500,000	7,000,000	11,000,000	80	15	52
Pittsburgh	4,544	56,500,000	34,000,000	15,500,000	80	15	83
Upper Freeport	17,824	91,000,000	500,000	54,000,000	70	15	34
Lower Kittanning	19,200	101,000,000	500,000	60,000,000	70	15	35
Stewart Township							Area 36,864 acres
Upper Freeport	10,029	60,000,000	8,500,000	35,000,000	80	15	40
Lower Kittanning	14,965	78,500,000	10,500,000	46,000,000	80	15	35
Brookville-Clarion	17,632	87,500,000	7,500,000	54,500,000	80	15	33
Upper Tyrone Township							Area 5,126 acres
Pittsburgh	3,436	51,500,000	51,000,000	350,000	90	15	100
Upper Freeport	5,126	32,500,000	--------------	19,500,000	70	15	42
Lower Kittanning	5,126	26,000,000	--------------	15,500,000	70	15	34
Washington Township							Area 6,515 acres
Redstone	2,000	11,000,000	2,000,000	6,000,000	80	15	36
Pittsburgh	5,526	70,500,000	68,000,000	2,000,000	90	15	85
Upper Freeport	6,515	62,500,000	--------------	26,500,000	50	15	64
Lower Kittanning	6,515	41,000,000	--------------	17,500,000	50	15	42
Wharton Township							Area 64,832 acres
Upper Freeport	28,560	205,500,000	7,000,000	135,000,000	80	15	48
Lower Kittanning	44,500	253,500,000	2,000,000	171,000,000	80	15	38
Brookville-Clarion	50,250	407,000,000	8,000,000	271,500,000	80	15	54

OIL AND GAS

Historical Account

The first producing gas well in Fayette County was completed in 1884. It is called the Bellevernon gas well No. 1 and is near the glass factory in the borough of Bellevernon, Washington Township. No large quantity of gas was produced. Two years later, in 1886, two small wells were drilled in Menallen Township. The first, the Thompson well* near Haddenville on the Fayette anticline, produced a small quantity of gas; the second, the Hugh Thompson well,† near Upper Middletown, likewise had only a small production. In 1887 the Brownsville No. 2 well† on Dunlap Creek in the borough of Brownsville was drilled in and produced a little gas. As none of the foregoing wells produced much gas, they cannot be considered as establishing a gas field.

The first gas field to be developed in Fayette County was opened with the completion of the Ryder well in 1887, followed by the Mack well early in 1888. These wells are 1 mile southeast of McClellandtown, in German Township. For many years this was called the Fayette gas field, although a few more recent writers referred to it as the McClellandtown field. In 1889 the Masontown field was opened with the completion of the Gray (Cats Run) well at the southeast corner of Masontown, German Township. Many other wells have produced in this field and a few still produced in 1935. After a break of several years, discovery was renewed by the David Gans well in Nicholson Township, which began production in the Old Frame field in 1899. The New Geneva field was developed in 1901 and was followed in 1902 by the Haddenville field, located a mile or so west of the Thompson well that was drilled at Haddenville in 1886. The Jacob Miller well, which was the first producer among the wells drilled at this time in the Haddenville field, is located a mile or more west of the Thompson well and was a very large producer. In 1906 the Joseph Elliot well in Jefferson Township started production in the Kenneth field, and in 1907 the G. M. Nelan wells 1 and 3, both in Luzerne Township, began production in the Luzerne and Antrim Run fields. In 1910 the Henry Walters No. 1 well, approximately 1 mile east of Waltersburg in Franklin Township, produced a small quantity of gas, but it was not until 1915 that any large producers were drilled in the Waltersburg field. In 1917 the Cox well in Luzerne Township began production in the West Luzerne field. In 1921 the J. S. Sangston well in German Township introduced production in the Highhouse field. That same year a small producer was drilled northwest of Dawson and a show of gas was obtained in a well 2 miles northeast of Connellsville, but no further drilling has been done near either of these wells to the writer's knowledge. In 1923 the Steve Filip well, 2 miles east of Perryopolis, Perry Township, came in and is still producing large quantities of gas. No other producers have been developed in this part of Fayette County. The same year the Fayette

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* Second Pennsylvania Geol. Survey, Annual Report, 1886, Pt. 2, p. 778.

† John F. Carll, Second Pennsylvania Geol. Survey, Report I5, pp. 319, etc., 1890.

‡ Op. cit., p. 317, 1890.

City field was introduced by the C. S. Brown No. 1 well in Washington Township. Drilling is still going on in this field at the rate of one or two wells a year.

During the development of the various fields in Fayette County, many dry holes have been drilled. Unfortunately the well logs and a great many of the locations have been lost.

Oil in Fayette County

The production of oil has never been important from Fayette County wells. Data are very meager not only as to amount of production, but even as regards the location and producing sands in the few wells that have produced oil. In 1921 Fayette County wells produced 1,721 barrels of oil. Production figures for other years are not available. Most of the oil comes from Conemaugh sands lying above the Upper Freeport coal, in particular from the Big and Little Dunkard sands. A small amount of oil has been recovered from the Big Injun sand along with the gas commonly present in this sand. Oil was encountered in the Dunkard sand in the Masontown field in 1920. The estimated flow was 5 barrels a day. In 1921 three wells were producing oil near Messmore in the Fayette field. One of them had a yield of 20 to 25 barrels a day, which was very large for a Fayette County oil well.

Sands

The available data on the sands encountered in drilling in Fayette County are very poor because many of the wells were drilled years ago when drillers did not keep detailed logs, and even of the more recent wells the logs are not as complete as might be wished.

Surface exposures of the Upper Devonian rocks several miles east of the gas-producing areas in Fayette County show the sandstones to be very irregular in thickness and position. The well logs indicate that the same is probably true of these rocks where they are deeply buried.

Correlation of gas sands. The logs of many wells in the gas fields were plotted to scale and grouped by townships or parts of townships. From these plotted sections a composite section was made for each township or area. These composite sections are grouped and correlated in Figure 133. The sections are aligned on the top of the Big Injun sand and the vertical scale gives the approximate distance of each sand above or below that horizon in each of the areas. From this figure also the approximate depth of any sand below the Pittsburgh coal in most of the gas fields can be determined. The figure shows that some sands are fairly continuous, and some are discontinuous or "strays." It illustrates also the variation in vertical position of the sands in different localities.

The use of names for the various sands is avoided so far as possible in this report because it is felt that it might lead readers to believe that any particularly named sand is continuous throughout the county, whereas, as a matter of fact, the sand is probably only a series of lenses at approximately the same distance below some given horizon.

From the driller's standpoint, the Big Injun sand is the most important in Fayette County, not only because it has produced large quantities of gas, but also because its persistency and thickness coupled with the presence of the Big Lime above make it the one horizon in the county that can invariably be recognized in a well log. Several other named sands do not have recognizable characteristics and their naming is based on the position in respect to the Big Injun sand or to some of the coals in the upper part of the well logs.

Graphical presentation of well logs. The logs of many of the wells drilled in Fayette County are presented in this report graphically rather than in the commonly accepted form which names the sands and gives their depths below the surface or below some definite horizon in the well. The well logs were plotted on coordinate paper with the top of the Big Injun sand used as the base from which the other sands were plotted. The Big Injun was selected for this purpose as it is the most easily recognized sand in the logs and occurs in nearly all. The surface is not shown, since it is of little moment in correlating the sands. A few wells are considerably deeper than the average and their lower sands are shown at the bottom of the graph with a number which indicates their distance below the Big Injun. It seems more advantageous to show the lower sands in this manner than to reduce the scale of all the wells so the sands could be placed in their proper position.

The advantage of this method of presentation of the well logs over the former method may be summarized as follows: The graphs present the data of the well logs exactly as taken by the drillers without giving either the writer's or the driller's interpretation and naming of the sands. It shows more clearly than numbers the variation in the thickness and position of the sands. It clearly fixes the grouping of the sands at certain horizons where such is the case. It leaves the question of correlations open so that any correlations that may be given can be checked against the data on which they are based. It does not sacrifice accuracy because the scale on which the logs are plotted shows the thickness and intervals of the sands as closely as is warranted by the logs.

The accompanying illustration (Figure 134) shows two profiles or cross sections of structure along the length of the gas fields, and one profile across the fields. It brings out the continuity but variation in thickness of the Big Injun sand, and better than Figure 133, the lenticularity of most of the other sands. It shows that the sands are mostly in zones rather than being definite units. The first continuous definite zone below the Big Injun sand represents the Murrysville sand and adjacent stray sands. This figure was constructed by M. N. Shaffner, who collected and plotted the well logs for it and for the next five figures.

The following five figures are a graphic presentation of the best well logs available. In Figures 135-9 the letter and number at the top of each column show the township and the number of the well in the township on the large map. The following is the key to the townships: B. Bullskin, F. Franklin, Gn. German, Gs. Georges, J. Jefferson, L. Luzerne, M. Menallen, N. Nicholson, Sh. Springhill, T. Lower Tyrone, W. Washington.

The gas sands are shown by the black strips. Where wedges are used, only the position of the top or bottom of the sand is given in the record. Coals are shown as reported. White blocks represent limestones as reported in the records. The small blocks above the larger ones are the Little Lime. G. stands for gas, SG. for show of gas, O. for oil. Black blocks with numbers at the bottom of the figures indicate the depths of sands below the top of the Big Injun.

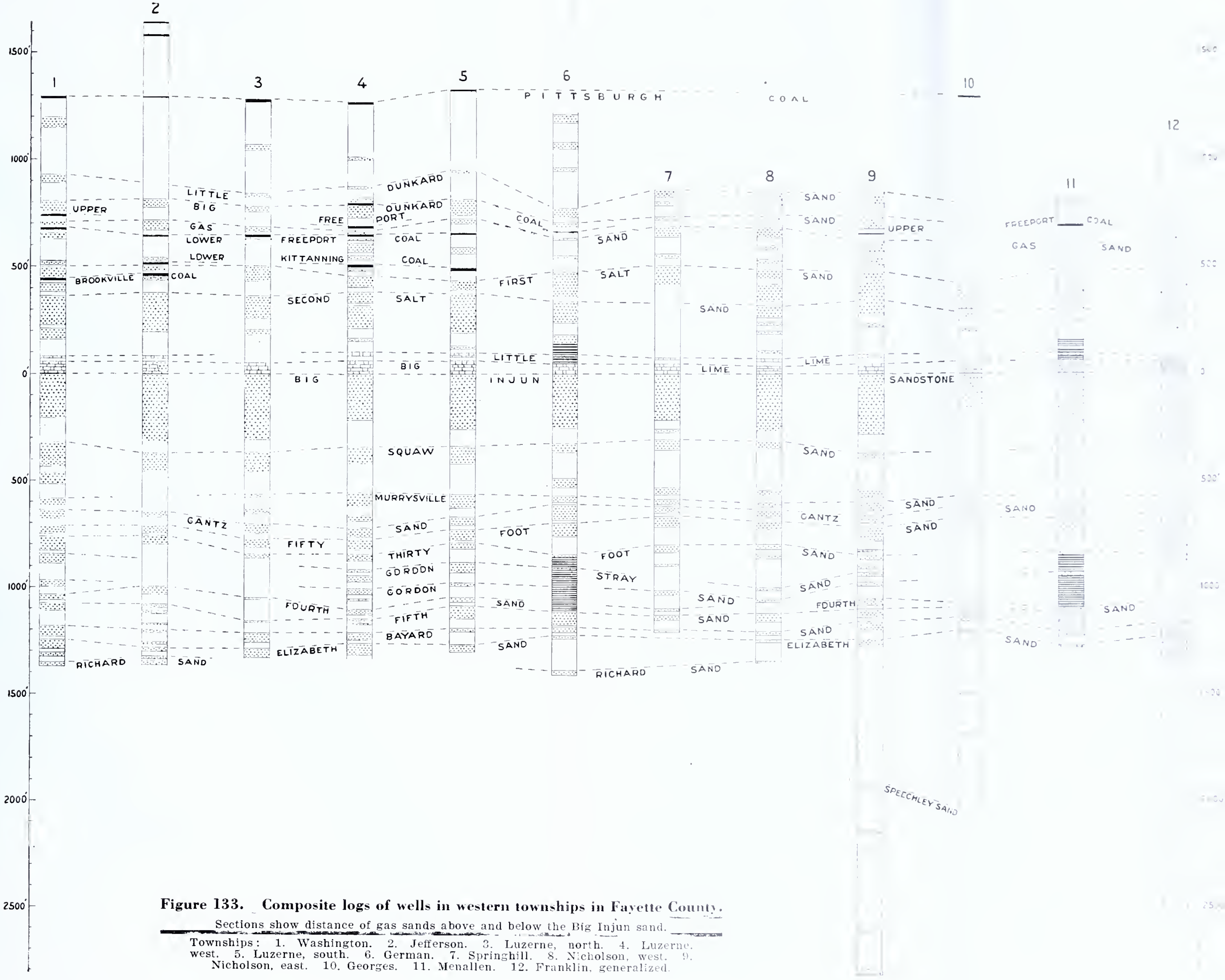


Figure 133. Composite logs of wells in western townships in Fayette County.

Sections show distance of gas sands above and below the Big Injun sand.

Townships: 1. Washington. 2. Jefferson. 3. Luzerne, north. 4. Luzerne, west. 5. Luzerne, south. 6. German. 7. Springhill. 8. Nicholson, west. 9. Nicholson, east. 10. Georges. 11. Menallen. 12. Franklin, generalized.

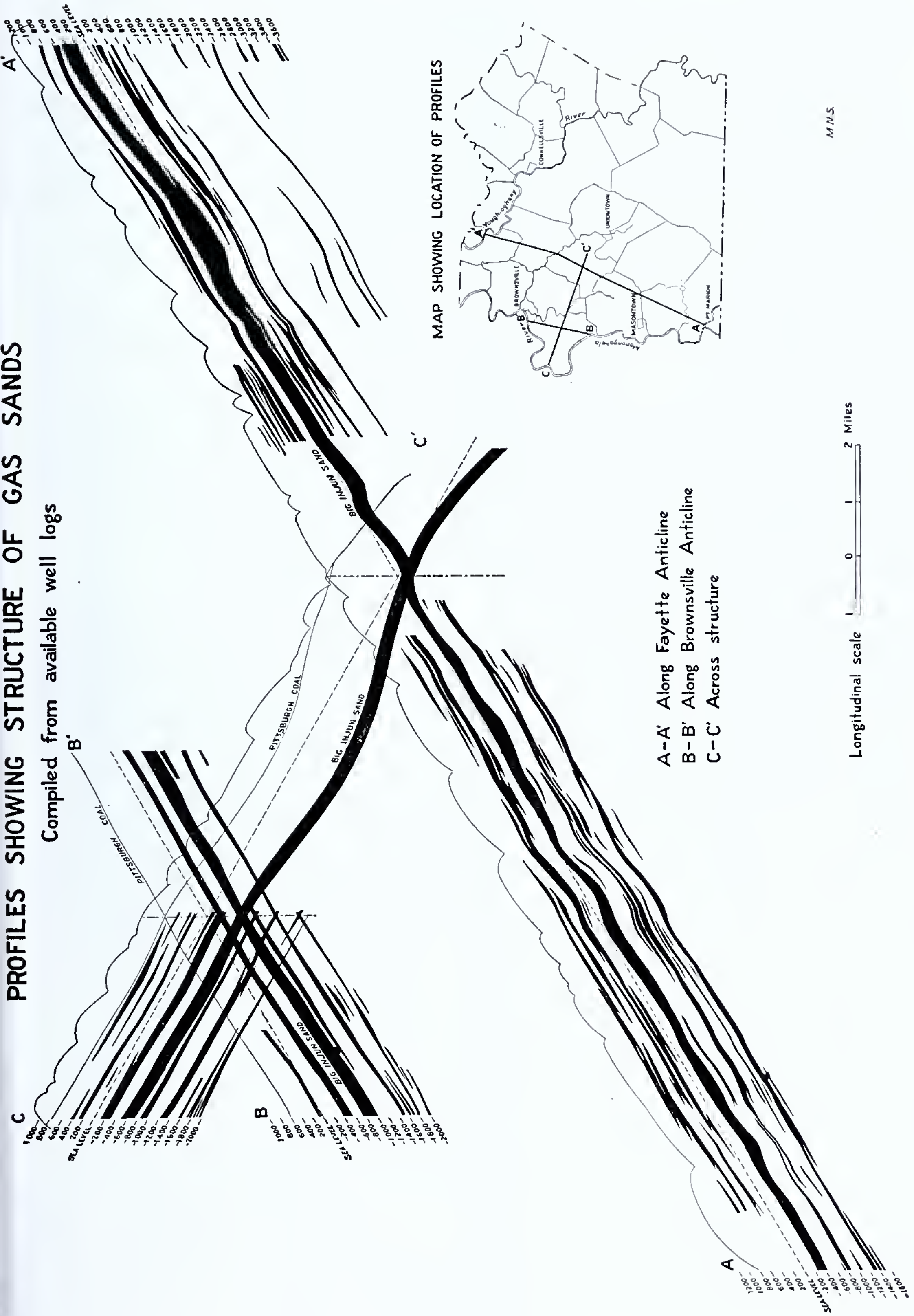
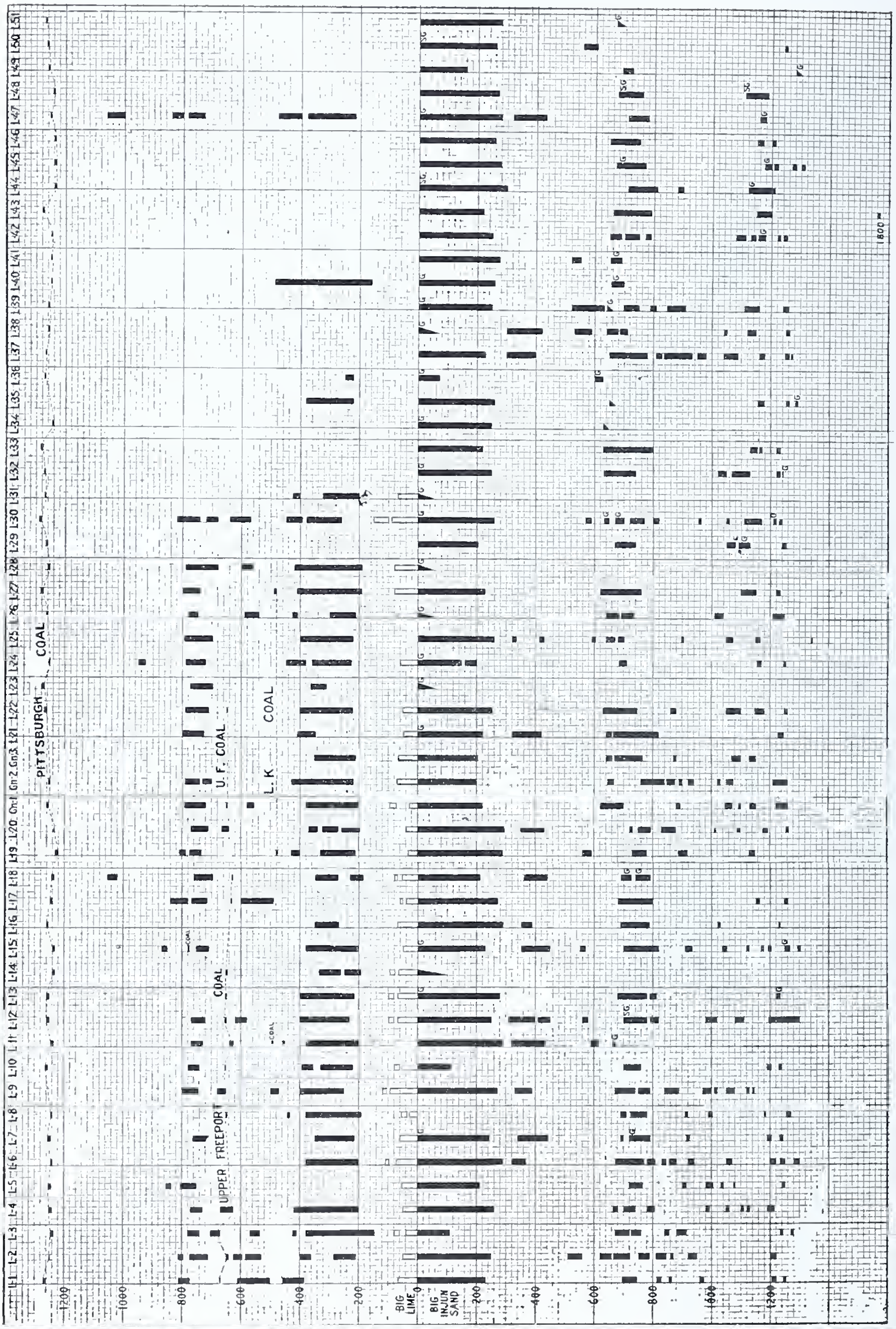


Figure 134. Cross sections showing lenticular character of gas sands in Fayette County.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L-3
L-4
L-5
L-6
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L-8
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Gn1
Gn2
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L-44
L-45
L-46
L-47
L-48
L-49
L-50
L-51
PITTSBURGH COAL
U. F. COAL
L. K COAL
UPPER FREEPORT COAL
COAL
BIG LIME
BIG INJUN SAND
G
SG
1200
1000
800
600
400
200
0
200
400
600
800
1000
1200
1800

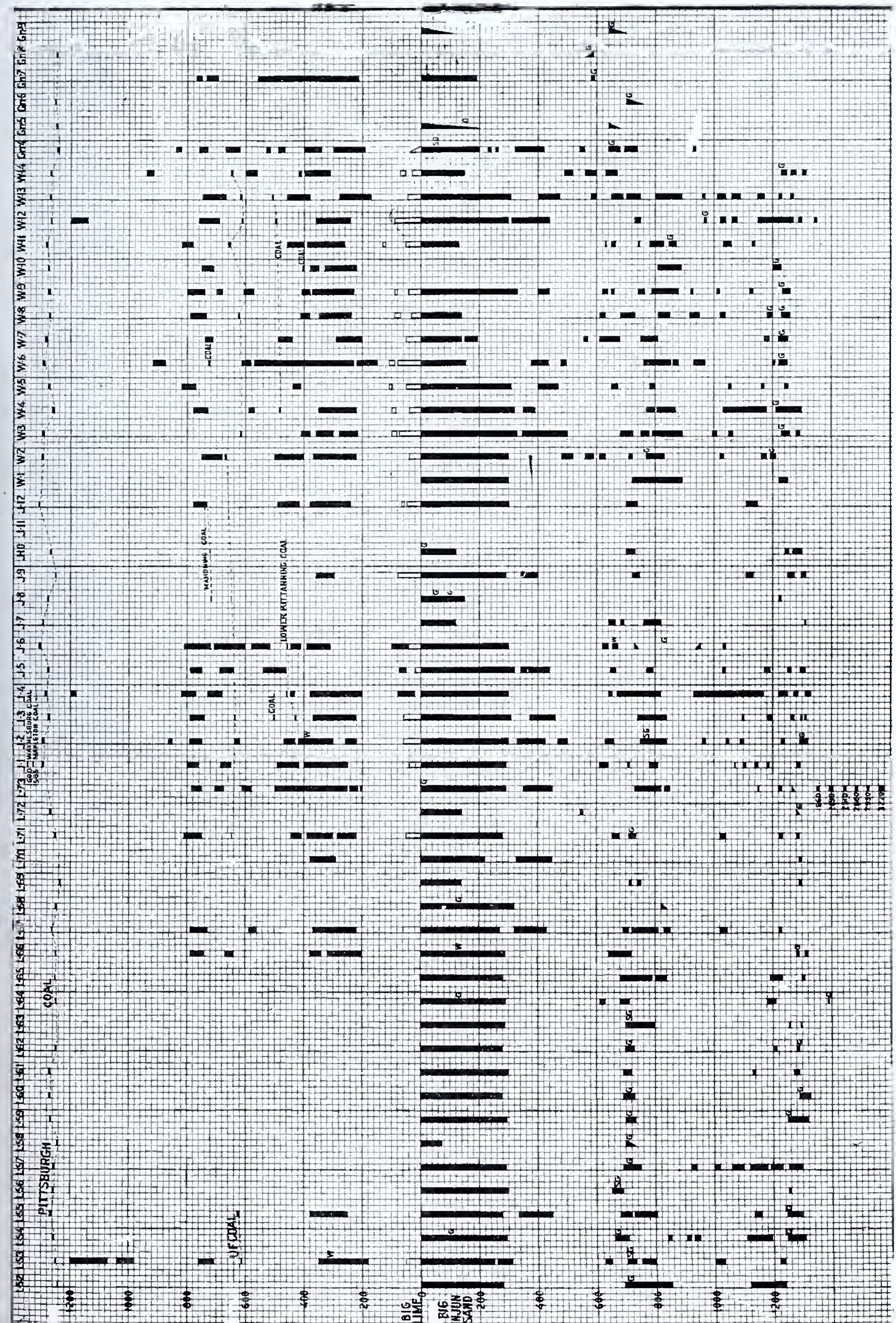
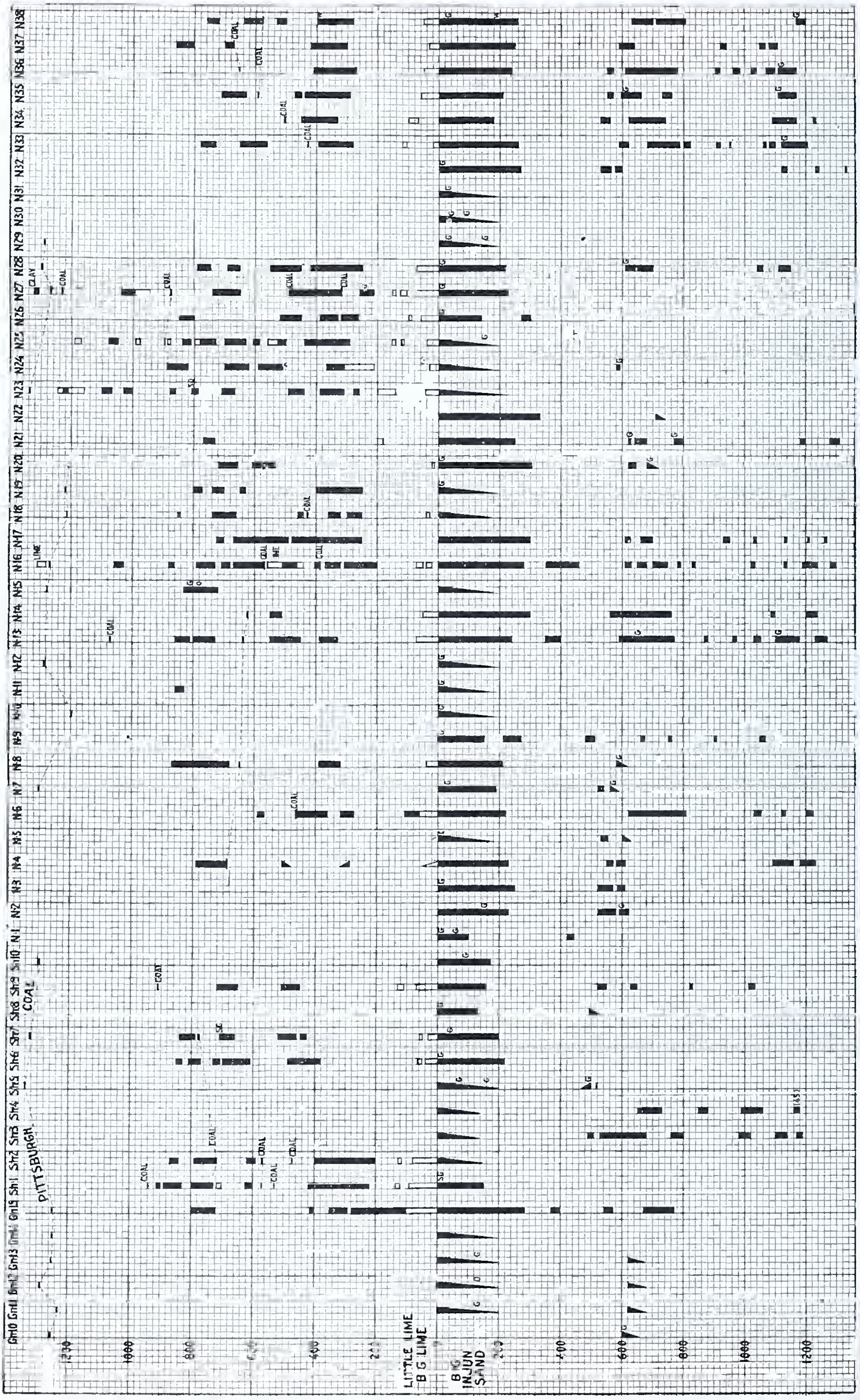


Figure 136. Skeleton logs of gas wells in Fayette County.


Gm10
Gm11
Gm12
Gm13
Gm14
Gm15
Sh1
Sh2
Sh3
Sh4
Sh5
Sh6
Sh7
Sh8
Sh9
Sh10
N1
N2
N3
N4
N5
N6
N7
N8
N9
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N11
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N16
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N27
N28
N29
N30
N31
N32
N33
N34
N35
N36
N37
N38
PITTSBURGH
COAL
CLAY
LIME
SD
G
1200
1000
800
600
400
200
LITTLE LIME
BIG LIME
BIG INJUN SAND
200
400
600
800
1000
1200

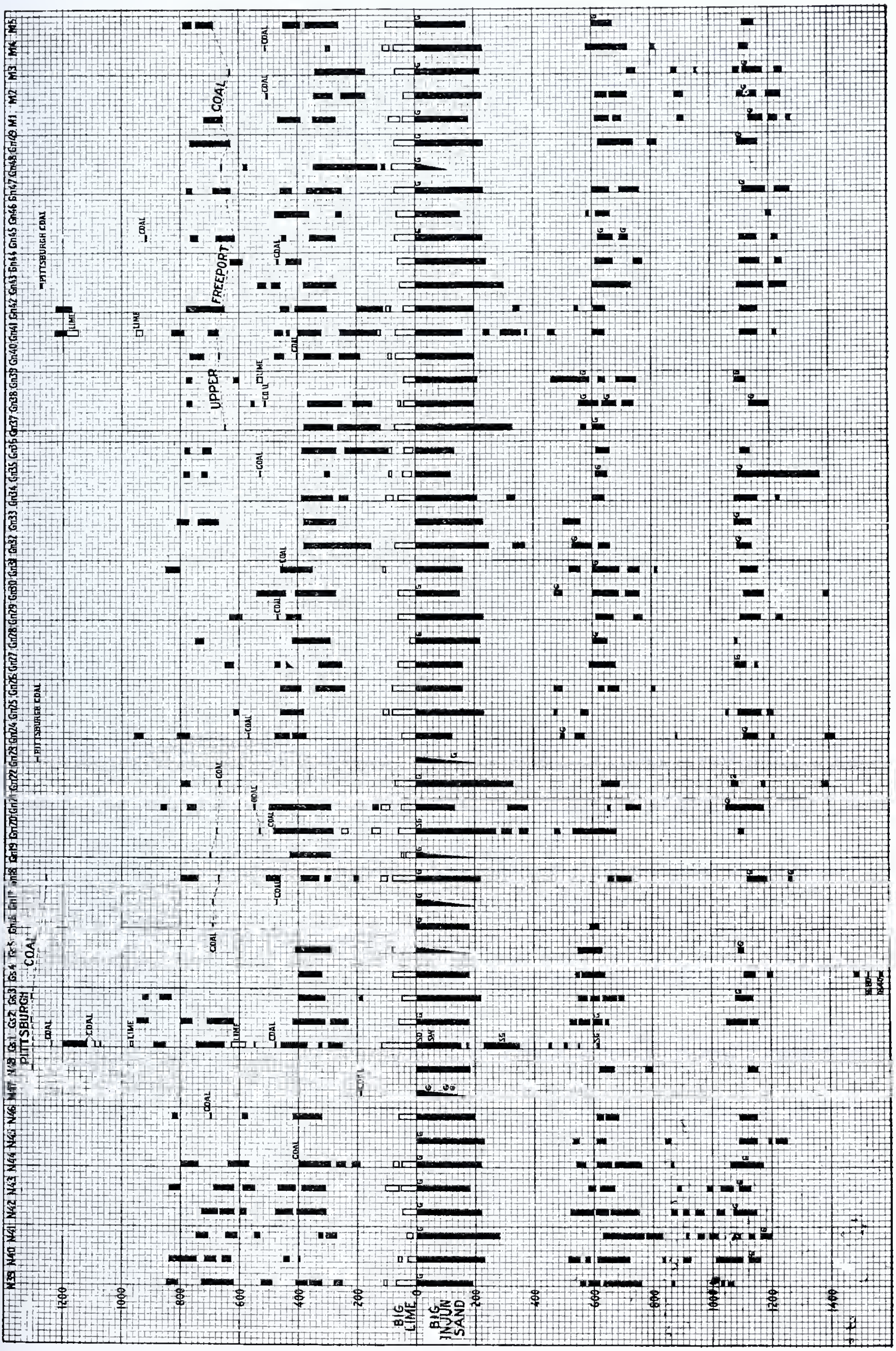

Figure 138. Skeleton logs of gas wells in Fayette County.

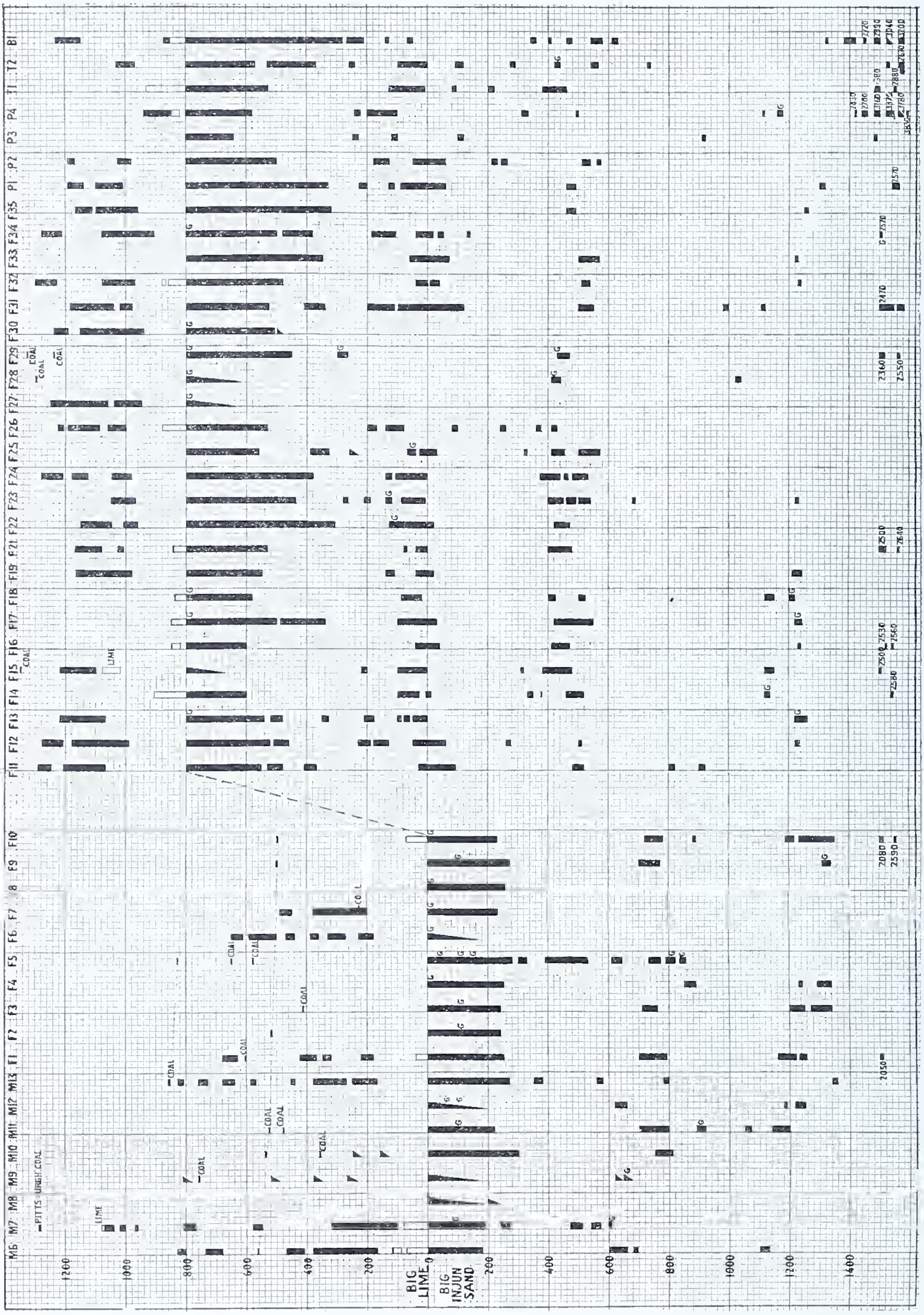

Figure 139. Skeleton logs of gas wells in Fayette County.

Geologic Structure

General. The strata of Fayette County have been compressed into northeast-southwest folds. The folds in the eastern part of the county have a much greater amplitude than those in the western part. Oil and gas production is confined to the smaller folds of the western part of the county, except for the recently discovered gas pool or pools on the Chestnut Ridge anticline. These folds are shown on the geologic and structural map in the pocket of the report by 100-foot contours on the Big Injun sand. Because of the inaccuracy of the well logs and elevations, the use of a smaller contour interval would be of doubtful advantage. The map of the gas fields, Fig. 140, shows the structural trends (anticlinal and synclinal axes) and their relationship to the gas fields.

Description of individual structures. The extreme western part of the county lies on the eastern flank of the Bellevernon anticline. The Port Royal syncline cuts through the northwest corner of the county, passing near Arnold City and Fayette City. It swings out of the county northwest of Brownsville to enter it again at the western edge of Bridgeport and, crossing Luzerne Township, leaves the county at Arensburg. The syncline is of small amplitude.

The Brownsville anticline begins as a small wing on the Fayette anticline near Redstone School and, increasing southwestward, develops considerable size near Brownsville; thence its course is to East Riverside, where it leaves the county. At the northern end this anticline has an amplitude of only 50 feet, but at Brownsville the amplitude has increased to 100 feet on the western side, and 250 feet on the eastern side. Between Brownsville and East Riverside the amplitude remains nearly 100 feet on the western side, but on the eastern side increases to more than 300 feet.

The Lambert syncline begins west of Perryopolis as a little trough between the Brownsville anticline and the Fayette anticline, progressing southwestward. It passes through Rowes Run, Brier Hill, Cardale and Dearthtown, leaving the county at Gates. The syncline reaches its maximum size between Brier Hill and Cardale.

The Fayette anticline enters the county 2 miles west of Tyrone Mills and runs southwest through Waltersburg, Haddenville, Balsinger and Woodside; it leaves the county at Point Marion. Throughout its length the axis plunges southward except for a few small high points which have a closure on the northern side of less than 50 feet. This anticline is of considerable size, having an amplitude along the sides of more than 500 feet, except at the very southern end, where the amplitude on the east is only about 100 feet.

The Uniontown syncline enters the county northeast of Everson and trending southwest passes west of Connellsville through Uniontown and Smithfield to leave the county in the vicinity of Lake Lynn. The deepest part of the syncline lies between Connellsville and Uniontown.

The Chestnut Ridge anticline enters the county about 3 miles east of Laurelville and trending southwest passes 3 miles east of Connellsville, 5 miles east of Uniontown, leaves the county south of Wymps Gap. The amplitude on the west side of the anticline ranges between 1,500 and 3,000 feet, whereas on the eastern side the amplitude is less, ranging between 800 and 2,000 feet. There are two main high points on this structure, one just north of the Springfield Pike, the other with its north end at Summit, extends 3 miles south along the crest of Chestnut Ridge.

The Ligonier syncline enters the county at Roaring Run and trending southwest passes through Whites Bridge, Ohiopyle, and Farmington, leaves the county southwest of Gibbon Glade. The syncline is of major proportions, lying between the great Chestnut Ridge and Laurel Hill anticlines. A few anticlinal rolls occur in this syncline, having amplitudes of less than 100 feet.

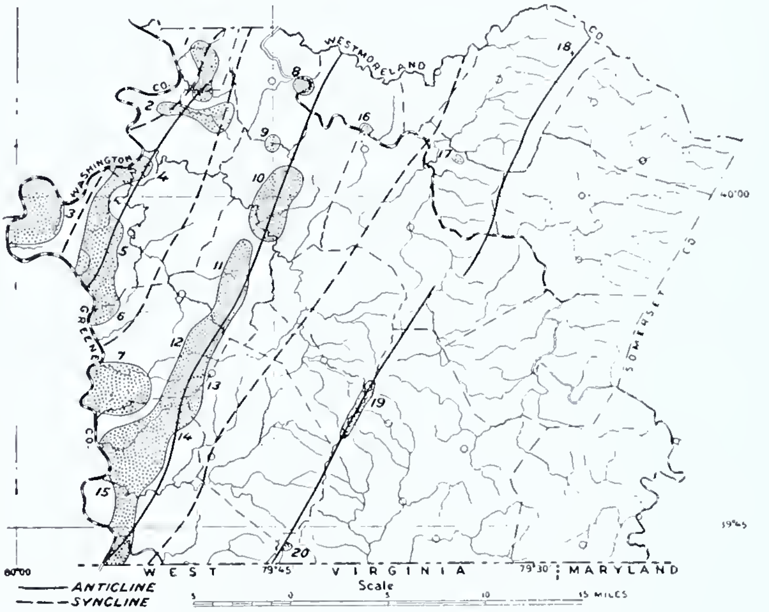

Figure 140. Map of natural gas fields in Fayette County.

1. Fayette City
2. Kenneth
3. West Luzerne
4. Brownsville
5. Luzerne
6. Antram Run
7. Masontown
8. Perryopolis
9. Curfew
10. Waltersburg
11. Haddenville
12. Fayette
13. Highhouse
14. Old Frame
15. New Geneva
16. Dawson
17. Connellsville
18. Anna Grimms well
19. Summit
20. Wymps Gap

The Laurel Hill anticline enters the county at its northeastern corner, and following close to the eastern edge of the county, crosses the Youghiogheny River near Bidwell, from which point it continues in a southerly direction through Beaver Creek School and Woodcock Hill to leave the county south of Boals School. This anticline has three high points within the county, the northernmost of which is at the northeast corner of the county, the second just north of Maple Summit School, and the third on the National Pike. The amplitude on the flanks is quite large, ranging from 1,500 to 2,500 feet.

The Johnstown syncline cuts through the extreme southeast corner of the county for about one mile.

Productive Gas Areas and their Relation to Structure

Fayette City field. The Fayette City field is almost entirely in Washington Township and takes its name from Fayette City just west of it. It was started in 1923. From its southern part on the Brownsville anticlinal axis the field extends northwest down the west flank of the anticline and across the Port Royal synclinal axis. At this point the fold is of small magnitude, the total amplitude on the anticline being not much more than 50 feet. Drilling is still active in the northern part of the field.

Kenneth field. The Kenneth field in Jefferson Township was opened in 1906 with the completion of the Joseph Elliot well at Kenneth. It extends across the Brownsville anticline in an east-west direction. The western end of the field lies on the Port Royal synclinal axis and the east end on the Lambert synclinal axis. The amplitude across the Brownsville anticline at this point is small, being 40 feet on the west and 80 feet on the east flank. A few wells have been drilled at the eastern end of the field in the last few years.

West Luzerne field. The West Luzerne field was discovered by the Cox well in 1917 and a few wells in this field were still producing gas in 1938. The productive area is in the western part of Luzerne Township and may be extended across the Monongahela River to join one of the larger gas fields of Washington or Greene counties. The field lies west of Port Royal syncline on the eastern flank of the Bellevernon anticline.

Brownsville field. The earliest production from the area of the Brownsville field began in 1887 near the borough of Brownsville on Dunlap Creek. This well produced little gas and no further drilling was successful until 1907, when production began in the Luzerne and Antram Run fields, which have grown so that they embrace the Brownsville area. The production in this field was short-lived and the original wells were dry by 1914. However, deeper drilling in recent years has produced more gas and one well was completed during the field work of this report. The field is along the axis of the Brownsville anticline, the northern part lying largely on the western flank, and the southern part of it on the eastern flank. Most of the productive area is in Luzerne Township, with a small part at the northern end in Brownsville Township, and at the southern end in German Township.

Masontown field. Production in the Masontown field began in 1888, and at the time of this report one well is still producing gas. The field is in German and Nicholson townships and extends across the Monongahela River for a short distance into Greene County. It lies well down the western flank of the Fayette anticline and close to the Lambert synclinal axis.

Perryopolis well. An isolated well 2 miles east of Perryopolis has produced large quantities of gas. The well is about half way down the west flank of the Fayette anticline.

Waltersburg field. The greater part of the Waltersburg field lies in Franklin Township. The field was first opened at its southern end, where in 1910 several moderately productive wells were drilled in. The initial rock pressure was 400 to 500 pounds. Not until 1915 did extensive development of this field begin, at which time several large wells came in and the field was extended northwest in the vicinity of Waltersburg. The field lies directly on the Fayette anticlinal axis and is still producing considerable gas after 25 years of life.

Fayette field. The Fayette field is the oldest in Fayette County and has produced gas since 1887, but not from the original wells. The field originated in German Township southeast of McClellandtown, which name has also been applied to it. The Haddenville, Highhouse, Old Frame, and New Geneva fields, all of which started subsequent to the Fayette field, and north and south of it along the Fayette anticline, have since grown so that all form one field at present. Most of the production from this field is on the west flank of the anticline near the crest, except for a small area near the middle of the field and another at the south tip, where there is some production from the eastern flank.

Dawson well. A gas well of moderate size a mile or so northwest of Dawson was drilled several years ago. It is now abandoned and there is no record of nearby drilling. This well is far down the east flank of the Fayette anticline.

Connellsville well. A show of gas was reported in a well 2 miles northeast of Connellsville. The well was half way up the steep west flank of the Chestnut Ridge anticline.

NATURAL GAS

Gas Production in Fayette County

In 1938 natural gas was being produced by 178 wells in Fayette County. The production was coming from Lower Mississippian and Upper Devonian sands. There are 11,000 acres of proved gas production in the county, and 30 billion cubic feet of gas had been produced prior to 1935. The deepest sand so far tested for gas in the county lies 5,070 feet below the Big Injun sand and in Middle Devonian strata. Figures giving yearly production of natural gas in the county are available for some of the recent years and are given in the table below:

Natural gas production in Fayette County

Year	Millions of cu. ft.	Year	Millions of cu. ft.
1920	1,721	1931	2,010
1921	1,735	1932	1,421
1922	2,596	1933	1,388
1923	3,022	1934	1,410
1924	2,267	1935	1,719
1925	2,812	1936	2,151
1926	2,320	1937	2,481
1927	2,201		

Possibilities of future development in Fayette County. A large part of the county has never been prospected, or if prospected, the drilling has only touched the upper sands in an incomplete fashion. The position of the productive gas areas in comparison with the anticlines shows that gas accumulation is not only controlled by geologic structure, but also to some extent by the character of the sands themselves. The character of the producing sands has never been investigated either by means of correlating the sands or by any other examination of the material. Therefore it is not possible to say what characteristics control the gas accumulation, but not far east of the producing areas these sands come to the surface in the gorges of the Youghiogheny River through Chestnut Ridge and Laurel Hill, at which points their character can be studied. Examination has shown that the sands are lenticular in nature and shaly material is common in them and very irregularly distributed. Thus it seems probable that both these characteristics have their effect on the permeability and porosity of the sands and affect gas accumulation.

Little drilling has been done at the north end of the Fayette anticline in Perry and Lower Tyrone townships. A few wells have been drilled to the upper sands along the crest of the anticline without discovering gas. However, wells drilled part way down on the western flank of the anticline have produced. There are two large producers, one east of Perryopolis, the other east of Curfew, both in Perry Township. So far as the writer knows, no other wells have been drilled in this part of the anticline, and it seems highly probable that more gas will be discovered with further drilling in this section. On the east flank of the anticline a well drilled northwest of Dawson produced gas in a moderate way for a while. It is the only well known so far down the east flank. It seems possible that some production may be disclosed by future drilling in this section.

The Laurel Hill anticline lies about 10 miles east of Chestnut Ridge and therefore is less favorably located as a source of gas because metamorphism increases to the southeast. It would seem advisable to test the Laurel Hill, since production is found on Chestnut Ridge. The isovol map of Pennsylvania, which gives a delicate test of metamorphism, shows that Laurel Hill is in about the same zone as the deep gas fields in Tioga County and therefore is a gas possibility. The structure of the anticline shows two high points that are more promising in their shape and configuration than any of the other anticlines in the county. One of these is near Bidwell, where the Youghiogheny River cuts through Laurel Hill, and the other at Woodcock Hill on the National Pike. As gas is found on Chestnut Ridge, the deep sands under these two structures would present interesting gas possibilities.

Drilling many years ago tested the upper sands in the Uniontown and Ligonier synclines. In nearly every case the sands were found to be dry, but one or two wells in the southern part of the Uniontown syncline showed traces of gas. Both of these synclines and the Johnstown syncline east of Laurel Hill are very steep and it seems unlikely that gas in commercial quantity will be found under them.

SUMMIT GAS POOL

By CHARLES R. FETTKE

History

The Summit Gas pool, opened in 1936, is under the crest of Chestnut Ridge in the vicinity of Summit, 4½ miles southeast of Uniontown. The pool, as developed at the end of 1939, occupies a narrow belt about 2½ miles long and 2,400 feet wide and, like the ridge, trends approximately N. 30° E. The National Pike crosses the pool at Summit.

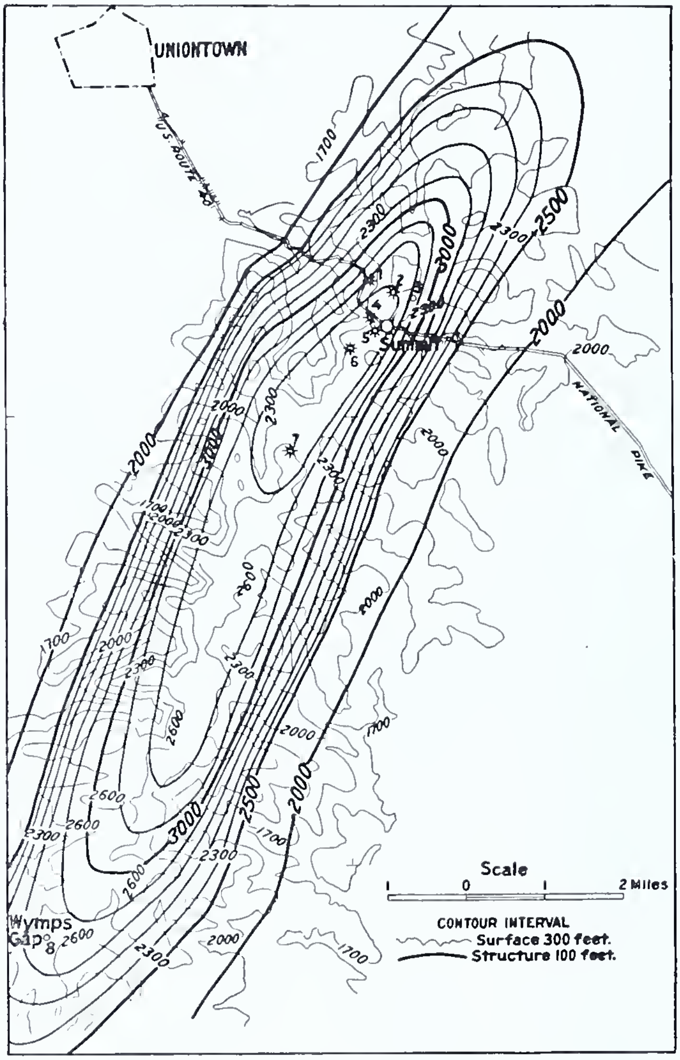

Figure 141. Map of Summit gas pool.

1. Snee and New Penn Piedmont No. 1
2. Sorg No. 1
3. Thompson No. 1
4. Heyn No. 1
5. Heyn No. 2
6. Peoples Piedmont No. 1
7. Indian Creek No. 1
8. Dunham No. 1

Structure on Upper Freeport coal.

William E. Snee of West Elizabeth, Pa., and the Potter Development Company, now the New Penn Development Corporation of Port Allegany, Pa., began drilling the first well to prospect the Oriskany sandstone for natural gas on the Leo F. Heyn property at Summit in March 1935. Gas was encountered in August 1936 at a depth of 6,611 feet in the upper part of the cherty Onondaga formation which overlies the Oriskany sandstone at this locality.

Six producing wells and one dry hole have been completed in the pool. A seventh well, the Sorg. No. 2, is drilling (January 1940), and a location for the eighth well, Peoples National Gas Company, Piedmont Coal Company No. 2, was made January 23, 1940. One deep test, Paul Dunham No. 1, drilled along the Chestnut Ridge anticline at Wymps Gap in the southwest corner of Wharton Township, got only a small flow of gas in the Onondaga formation. This well is about seven miles south of the nearest producing well in the Summit pool and is more than 1,000 feet lower on structure as measured on the top of the Onondaga formation. Although close to the axis of the anticline, this well is far down on the southwestern pitch of the Summit dome. The records of the above wells, including skeleton logs, are given in the following table:

Records of wells in Summit gas pool, Fayette County

Lessor	Name of well	Altitude	Upper Devonian red beds			Tully			Onondaga			Oriskany		Total depth	Initial open flow	Initial pressure lbs. per sq. in.	Date completed
			Depth	Thickness	Interval to Tully	Depth	Thickness	Interval to Onondaga	Depth	Altitude	Thickness	Depth	Thickness				
Wm. E. Snee and New Penn Development Corporation	Leo. F. Heyn No. 1	2316	355	400	5666	6021	79	551	6572	—4256				6690	1,800 M	3025 to 3050	4-23-37
Wm. E. Snee and New Penn Development Corporation	Leo. F. Heyn No. 2	2464				6085		587	6672	—4208				6767	3,500 M	2985	3-24-38
Greensboro Gas Co.	John R Thompson No. 1	2542	759	348	6001	6760	111	597	7357	—4815	199	7556	111	8159	Shot at 7370-7420 Show of gas		8-12-38
Peoples Natural Gas Company	Piedmont Coal Company No. 1	2369	305		5605	5910	85	600	6510	—4141	199	6709	95	6825	2,680 M at 6570-6709	2910	1- 5-39
Wm. E. Snee and New Penn Development Corporation	Indian Creek Coal and Coke Company No. 1	2630	598	414	5642	6240	112	674	6914	—4284	189	7103		7147	928 M from Onondaga	2910	4- 6-39
Wm. E. Snee and New Penn Development Corporation	Piedmont Coal Company No. 1	2178	232	448	5828	6060		602	6662	—4484					2,000 M 1-9-40		Drilling at 6799 1- 9-40
W. W. Wasson et al.	Mrs. J. H. Sorg No. 1	2580	733	344	5668	6401	91	524	6925	—4345	184	7109		7114	1,900 M one-half from Oriskany	2980	3-10-39
L. J. Houze Convex Glass Company	Paul Dunham No. 1[1]	2199	727	485	5900	6627	78	881	7508	—5309	190	7698	73	7826	50-200 M in Onondaga		6- 9-39

[1] James H. C. Martens, Petrography and correlation of deep-well sections in West Virginia and adjacent States: W. Va. Geol. Survey, 1939, pages 74-80.
M=1,000 cubic feet.

Three pipe lines serve the Summit pool (January 1940), namely, an 8-inch line, 28½ miles long, which connects with the Carnegie Natural Gas Company's system; a 4-inch line, 2½ miles long, which connects with the Manufacturers' Light and Heat Company's system; and a 4-inch line, 19½ miles long, which delivers gas to the plant of the L. J. Houze Convex Glass Company at Point Marion, Pennsylvania.

Subsurface Stratigraphy

Complete sets of drill cutting samples have been studied by the writer from the Heyn No. 1 and the Thompson No. 1 wells and from a depth of 1,835 feet to the bottom of the Sorg No. 1. Logs made from the drill cuttings from the Heyn and Thompson wells, giving in detail the sequence of strata, are published in Pennsylvania Geological Survey progress report 124, and accompanied by a discussion of the subsurface stratigraphy.

In the Thompson well, the deepest in the area, 350 feet of limestones with minor amounts of interbedded shales in the lower part have been assigned to the Helderberg group, the base of the Devonian system having been placed tentatively at a depth of 8,017 feet. In western Pennsylvania it is difficult from studies of well samples to draw the line between limestone of the Helderberg group and Silurian limestone. The former is non-magnesian, in part cherty, and frequently very fossiliferous. The latter usually is magnesian and nonfossiliferous or only sparsely so, and in most of the area anhydrite appears a short distance below the top. Although no anhydrite was observed in the 142 feet of limestone below 8,017 feet penetrated by the well, the limestone is decidedly magnesian in character.

Structure

The Summit pool is on the crest of the Summit dome. This elongated dome along the axis of the Chestnut Ridge anticline with a closure of approximately 1,000 feet as mapped on the surface beds, is the most prominent structural feature in Fayette County.

In the well highest on the structure, the Piedmont No. 1 of the Peoples Natural Gas Company, the top of the Onondaga formation, from which the gas is obtained, has an altitude of 4,141 feet below sea level. Along the axis of the fold in a northeasterly direction, the average pitch between this well and the Sorg No. 1 is 4.7 feet per 100 feet over a distance of 4,300 feet. In a southwesterly direction between it and the Indian Creek No. 1, the pitch is 1.7 feet per 100 feet over a distance of 8,500 feet.

On the northwest flank of the dome the Snee and Piedmont No. 1 at the north end of the pool was completed in January 1940. In this well, 1,800 feet northwest of the Sorg No. 1, the top of the Onondaga is 139 feet lower, indicating an average dip of 7.8 feet per 100 feet in that direction. This well, with the top of the Onondaga 343 feet lower than in the highest well, is, at present, the lowest producer on the structure.

On the southeast flank of the anticline in the Thompson No. 1 well, 1,000 feet east of the Sorg No. 1, the top of the Onondaga is 470 feet lower than in the Sorg. This relatively abrupt drop is probably due to the presence of a reverse fault with a northwest dip and a strike approximately parallel to the long axis of the dome. Although the existence of this fault has not been established definitely in the outcropping strata, the results obtained in the Thompson well seem to indicate that production on the southeast flank of the dome can be expected to terminate along such a fault a relatively short distance southeast of the axis of the fold.

Reservoir Rock

With the possible exception of the Sorg No. 1 well, all wells in the Summit pool are obtaining their production from the Onondaga formation. The uppermost 3 to 30 feet of this formation consist of a dense, very dark brownish-gray, argillaceous limestone. The rest of the formation is made up largely of a light to dark brownish-gray chert, in part silty and to a considerable extent non-calcareous. In the lower portion, considerable dark brownish-gray to black shale occurs interbedded with the chert. Occasional glauconitic zones are present. The total thickness of the formation ranges from 184 to 199 feet.

The first gas is obtained anywhere from 40 to 70 feet below the top of the formation and the flow increases at intervals until the bottom is reached. Several of the wells have not been completed through the entire thickness. The Heyn No. 1 well, drilled to a depth of 95 feet below the top of the formation, on April 23, 1937, had an open flow capacity of 1,800,000 cubic feet per day. Early in the summer of 1939, after the open flow had declined to approximately 675,000 cubic feet per day, the well was drilled 23 feet deeper. Drilling was stopped when the open flow had increased to 6,900,000 cubic feet per day.

Unfortunately no cores of the pay portions of the Onondaga formation have been obtained, and the drill cuttings are too fine to yield any definite information in regard to the nature and amount of the pore space. Some of the silty chert particles appear to contain minute pores. Occasional particles show slickensides and others are intersected by minute quartz veinlets, both of which suggest fracturing. It seems probable, therefore, that the pore space is partly primary and partly secondary.

Only one well, the Sorg No. 1, is reported to have obtained any production from the Oriskany sandstone, although two other wells within the pool have penetrated this formation. The Sorg well was completed only five feet in the sandstone, but in this interval its open flow approximately doubled. When the gas was turned into the line several months later, however, a drastic drop occurred and the amount actually obtained was more nearly in line with the open flow shown before the Oriskany was reached.

The Oriskany sandstone, which ranges in thickness from 73 to 111 feet in the area, is calcareous throughout. Portions of it consist of sandy limestone rather than true sandstone. Two cores, one 6½ inches long, and the other one inch, were obtained from the upper ten feet of the sandstone in the Peoples Natural Gas Company's Piedmont Coal Company No. 1 well, drilled with rotary tools. These had total porosities of only 1.5 and 1.6 percent by volume, respectively. Both contained considerable quantities of calcite cement.

Production and Reserves

It is estimated that the Summit pool at the end of 1939 had produced approximately three billion cubic feet of gas. This includes the gas used for drilling purposes and that which has been lost in drilling in the wells.[1] The original reservoir pressure of the pool was between 3,025 and 3,050 pounds per square inch. No accurate measurements of the extent to which this has declined have been made. On December 24, 1939, the Heyn No. 2 well, after being shut in for 22 hours, registered a pressure of 2,000 pounds per square inch. This well is midway between and 1,200 feet from two other wells which were not shut in at the time. It would appear, therefore, that at the end of 1939 the average reservoir pressure was still well over 2,000 pounds.

All the wells drilled thus far in the area have been producers with the exception of the Thompson well and the Dunham well. Conditions in the Thompson well indicate that production on the southeast flank of the structure probably terminates against a fault a short distance southeast of the axis of the fold, and the Dunham well, seven miles southwest of the southernmost producing well, is far down the pitch in that direction. An effective closure of at least 340 feet has been demonstrated on the northwest flank. No salt water thus far has been encountered in any of the wells, but a little fresh water condenses from the gas, one measurement indicating about 6 gallons per 850,000 cubic feet of gas. The limits of the pool have not been outlined sufficiently to determine the total productive area.

Because of the relatively low permeability of the reservoir rock as witnessed by the low initial open-flow capacities of the wells when compared with the Oriskany sand wells of north-central Pennsylvania and south-central New York, it is impossible to predict what the lowest pressure will be at which the wells will yield commercial volumes of gas. The ultimate recovery that may be expected from the Summit pool is difficult, if not impossible, to estimate at present. It is the first pool of its type to be developed in the State and too little is known concerning the nature of its reservoir rock to predict its behavior.

CLAY AND SHALE

By HENRY LEIGHTON

General Account

Samples of the fire clays of Fayette County collected in 1925 were tested by Prof. J. B. Shaw of State College and the results published.[2] A more complete study of the clays was made in 1929-1932 by Henry Leighton with laboratory tests by J. B. Shaw.[3]

The present discussion is a summary of the facts brought out in the two mentioned reports with additional information collected in 1933-34 and additional tests, all of which were made by J. B. Shaw.

Three types of clay and shale in Fayette County are suitable for the manufacture of ceramic products, (1) the unconsolidated terrace clays of the Carmichaels formation; (2) shales ranging from Devonian to Permian in age; and (3) fire clays, plastic or flint, in the Pottsville, Allegheny or Conemaugh groups.

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[1] Wm. E. Snee, Oral communication, January 4, 1940.

[2] Shaw, J. B., Fire clays of Pennsylvania: Pennsylvania Top. & Geol. Survey, Bull. M-10, 1928.

[3] Leighton, Henry, Clay and shale resources of southwestern Pennsylvania: Pennsylvania Top. & Geol. Survey, Bull. M-17, 1932.

Carmichaels Clay

Stratigraphy. Carmichaels deposits are found on terraces bordering the Monongahela River and 200 feet or more above river level. They represent deposits formed by a predecessor of the Monongahela River, which flowed at this higher level previous to and during the early part of the Glacial period. The remnants of these old river deposits are termed the Carmichaels formation. They consist of sands, gravels and clays in variable thickness up to 80 feet. The clays are usually yellow, but in small areas are bluish-gray to nearly white. These terrace clays are exposed in many areas along the Monongahela Valley, such as back of Bellevernon, in and around Masontown, in the vicinity of New Geneva, at Perryopolis, and across the Youghiogheny River from Connellsville.

Deposits. In 1857 a pottery began operations in New Geneva using Carmichaels clays from pits south of the city. At the same time a pottery was established across the river at Greensboro and in 1866 a second one was built. Some of the clay for the Greensboro plants was obtained from New Geneva pits. In these potteries the clays were used in the manufacture of blue stoneware, jugs, crocks and roofing tile. They were glazed with salt glaze and Albany slip clay. In 1896 a pottery was erected 1 mile north of Point Marion on the east bank of the Monongahela River.

All of these potteries have been abandoned for years and no clay products are made at present from the Carmichaels clays. The clays, however, are highly plastic and have a high green strength. One sample (see below No. 94) was collected from a pit half a mile south of New Geneva, the material being a laminated, somewhat sandy clay used in foundry work. Samples of Carmichaels clay collected in Greene and Washington counties and described by Leighton (1932) give additional data on the value of the clay. Some can be used in the manufacture of red face brick, drain tile, fireproofing and in some cases sewer pipe and paving brick. The chief factor against their present use is the irregular pockety character of the better clays and their limited distribution. Their best use would probably be in the manufacture of special art pottery in small plants and from small deposits.

Physical and chemical analyses of Carmichaels clay from ½ mile southeast of New Geneva

Sample number	94	Maximum shrinkage at cone	1
Water of plasticity, percent	32.2	Fusion point, cone	17
Linear drying shrinkage, percent	7.6	Best burning range, cones.	07–4
Time of slaking, minutes	9	Firing color, tan	
Modulus of rupture, lbs. sq. in.	351	Suggested use, doubtful	
Maximum linear burning shrinkage	9.6		

	Percent		Percent		Percent		Percent
SiO_2	62.13	Al_2O_3	21.16	Na_2O	0.84	P_2O_5	0.04
Fe_2O_3	4.33	CaO	1.78	K_2O	0.49	SO_5	0.24
TiO_2	1.31	MgO	3.17	MnO	0.07	Ignition	5.25

Shales

Stratigraphy. As may be seen from the many stratigraphic sections in this report, shales are abundant throughout the county. There are sandy red and gray shales in the Upper Devonian, red shales in the Mauch Chunk series and a few unimportant shales in the Pottsville series. The greater development of shales and the better quality are in the Allegheny and Conemaugh groups, with poorer shales in the Monongahela and Dunkard groups.

Quarries and brick plants. At present there is but one brick yard in the county manufacturing building brick. This is the plant of the Perry Manufacturing Co. at Perryopolis. The section in their quarry shows:

Feet	
15	Varved Carmichaels clay
3	Sandstone
15	Blue shale
1	Limestone (Brush Creek)
8	Black shale
2½	Coal

The material used is a mixture of the Carmichaels clay and the blue shale. The product is a good quality of red building brick and rough scratch brick. The shale is dug with an electric shovel and hauled to the plant by a Plymouth gasoline locomotive. The shale is ground in two dry pans, molded in a Freese auger machine, and burned in two round and one rectangular kilns, fired with coal.

Two brick yards have in the past used shales in the manufacture of brick. The first is the Jos. Soisson Fire Brick Company at Moyer. This plant now manufactures firebrick, but has made red-face brick from a shale bank just east of the plant. The beds are of Upper Conemaugh age and the quarry shows the following section:

Feet	
20	Buff shale (Sample No. 98)
6	Sandstone
2	Shale
2	Limestone
3	Dark coaly shale
3	Limestone
4	Gray crumbly shale
10	Sandstone and shale
4	Red clay with limy nodules
2	Green sandy shale
1	Limestone

The upper 20 feet of shale (No. 98) shows fair plasticity and low green strength. It fires to a dark red color with a firing range of cone 07 to cone 1. It fuses at cone 11. This upper shale was the material used and it makes a very satisfactory red face brick.

The other plant, long since abandoned, was at the east end of the Cheat River bridge at Point Marion. Here olive and buff shales of upper Conemaugh age were made into red brick. In the same quarry there is a buff clay 4 feet thick (No. 92) which shows good plasticity and fires to a tan to olive color with a burning range of cone 07 to cone 1. This seems suitable for drain tile and fireproofing, or could be mixed with the shales to advantage.

The shales along the Monongahela River are of Conemaugh and Monongahela age, the better shales being in the Conemaugh group. Tests were made (Leighton 1932) on samples of such shale near the Masontown bridge (No. 96), north of New Geneva (No. 95), and in the southwestern borders of Point Marion (No. 93). These all burn to a uniform red color with a burning range of cone 07 to cone 02 to cone 1 and should make satisfactory red-face brick or drain tile.

Between the Monongahela Valley and Chestnut Ridge the shales are chiefly of Monongahela and Conemaugh age and are not worked.

In the Chestnut Ridge and Laurel Hill areas the best shale for brick making is the Mauch Chunk series of red clays and shales and this is readily accessible in the gaps of the Youghiogheny River between Connellsville and Confluence. A sample (No. 227) was collected from a 35-foot bed along the National Highway on the west slope of Chestnut Ridge. The material shows good plasticity and green strength and burns red with a firing range of cone 07 to cone 4. It should make good face brick and hollow tile. Between Chestnut Ridge and Laurel Hill, Allegheny and Conemaugh shales are available, but none were noted of any great value. Tests were made by J. B. Shaw on samples of such shales as follows:

Localities from which samples tested were obtained

92. Clay under sandstone at Point Marion bridge.
93. Shale at southwest edge of Point Marion.
95. Shale on railroad north of New Geneva.
96. Shale on railroad north of Masontown.
98. Upper shales, Soisson brick yard, Moyer.
227. Mauch Chunk shale, west slope of Chestnut Ridge on National Highway.

Physical tests of Fayette County shales

Sample number	Percent water of plasticity	Percent linear drying shrinkage	Time of slacking, minutes	Modulus of rupture, pounds per sq. in.	Maximum linear burning shrinkage	Maximum shrinkage at cone	Fusion point	Best burning range cones	Firing color	Suggested use
92	27.6	9.5	5	243	8.6	1–4	13	07–1	Tan to olive brown	Drain tile, fireproofing
93	25.4	9.5	3	306	7.8	02	11	07–02	Uniform red	Face brick, drain tile
95	25.8	7.1	4	160	7.2	1	7	07–1	Light to dark red	Common brick
96	26.1	4.5	5	140	6.1	1	7	07–1	Uniform dark red	Common brick, drain tile
98	26.0	5.5	5	145	9.1	1	11	07–1	Salmon to dark red	Face brick, drain tile
227	17.8	3.7	8	225	6.0	4	12	07–4	Red to brown	Face brick, hollow tile

Chemical analyses of Fayette County shales

No.	Ign.	SiO_2	Fe_2O_3	TiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	MnO	P_2O_5	SO_3
92	7.65	58.02	4.03	.37	27.67	1.22	1.23					
93	7.43	53.85	8.14	1.38	19.63	1.63	2.67	1.95	1.54	.48	.36	.41
95	12.85	49.54	10.48	.74	17.64		6.38	.17	.10	.001		
96	9.65	49.81	5.71	.24	23.48	1.65	2.37	3.88	1.89	.04	.01	.28
98	5.80	62.49	6.51	.73	21.67	2.01	1.02	.25	.15	.02	.27	.06
227	5.03	62.64				.85	.71					

No. 396. Tough shale, 1 mile northeast of Farmington on the Ohiopyle road.

Green properties: Plasticity rating, 60; linear drying shrinkage, 4 percent

Fired properties

Cone	04	02	1	3	5	7	9
Degrees C.	1060	1125	1160	1170	1205	1250	1285
% vol. shrinkage	3.0	11.0	13.5	14.0	17.1	20.5	*
% absorption	13.6	10.9	9.0	8.0	6.5	4.0	
% porosity	37.0	31.2	29.6	25.5	17.3	13.6	

*Overfired.

Fired color. Salmon to dark brown.
P. C. E. (Fusion) cone 11. (1325° C. or 2417° F.)
No commercial value.

No. 399. Buff shale, ½ mile west of junction of Routes 40 and 381 on Route 28. Near Farmington.

Green properties: Plasticity rating, 60; linear drying shrinkage, 3 percent

Fired properties

Cone	04	02	1	3	5	7	9
Degrees C.	1060	1125	1160	1170	1205	1250	1285
% vol. shrinkage	3.5	13.0	15.4	16.0	17.0	21.0	25.0
% absorption ...	26.2	22.0	17.5	14.5	12.0	10.5	7.5
% porosity	47.0	40.0	32.5	25.5	21.0	19.0	12.5

Fired color. Salmon to dark gray.
P. C. E. (Fusion) cone 11. (1325° C. or 2786° F.)
A poor quality shale. Color not attractive.

No. 400. Clay under Brush Creek limestone, east of Perryopolis brick yard.

Green properties: Plasticity rating, 60; linear drying shrinkage, 6 percent

Fired properties

Cone	04	02	1	3	5	7
Degrees C.	1060	1125	1160	1170	1205	1250
% vol. shrinkage	0	3.0	4.1	5.2	7.0	13.9
% absorption	19.8	19.0	17.5	15.8	12.0	9.6
% porosity	34.0	32.5	31.5	30.0	19.0	—

Fired color. Red to brown.
P. C. E. (Fusion) cone 11. (1325° C. or 2786° F.)
Over fires at cone 9. Not much commercial value.

No. 418. Tough clay shale, 1½ miles north of Elliottsville on the Wharton Furnace road.

Green properties: Plasticity rating, 50; linear drying shrinkage, 6 percent

Fired properties

Cone	1	3	5	7	9	11
Degrees C.	1160	1170	1205	1250	1285	1325
% vol. shrinkage	6.0	4.0		Swells		
% absorption	8.0	6.0	4.0	2.3	2.0	1.1
% porosity	14.1	9.2	7.0	3.6	3.0	1.6

Fired color. Dark brown.
P. C. E. (Fusion) cone 16. (1465° C. or 2662° F.)
No value—poor quality.

Fire Clays

Stratigraphy. The fire clays of Fayette County are associated with the coals of the lower Conemaugh group, the Allegheny group and the Pottsville series. There are no fire clays in the Devonian and Mississippian strata and none above the Brush Creek horizon in the Conemaugh with the exception of a thin "draw slate" or parting in the Pittsburgh coal bed. This parting is a 1-foot bed of shaly clay which lies between the main bench of Pittsburgh coal and the roof coal. It has been used at Manown and Courtney in the manufacture of firebrick shapes not requiring too-high temperatures, the material being saved during coal-mining operations. From tests made in adjoining counties it is evident that it is semi-refractory to refractory in character and can be used in buff face brick or low-heat duty refractories. A sample (No. 241) taken from a coal stripping east of West Newton fused at cone 32. Aside from this thin clay in the areas of Pittsburgh coal, all the fire clays are confined to the areas where there are outcrops of the Buffalo and Mahoning members of the Conemaugh group, the Allegheny group or the Pottsville series. These areas can be divided into (1) the Jacobs Creek area, (2) the Layton-Dickinson area on the Youghiogheny River, (3) the west flank of Chestnut Ridge, and (4) the area between Chestnut and Laurel ridges.

Jacobs Creek area. West from Tyrone Mills for a few miles Jacobs Creek has cut a deep valley across the Fayette anticline, exposing the Lower Conemaugh and the entire Allegheny group. The cut is now followed by the Pittsburgh & West Virginia Railroad, making the clays accessible in an area long closed to development. As will be seen by reference to the measured Allegheny sections, Figure 44, several clays are exposed along this railroad, including a 5-foot bed of plastic clay a few feet below the Upper Freeport coal, a 6- to 14-foot clay below the Lower Kittanning coal and a 5-foot bed below the Clarion coal, with several thinner clays at other horizons. In the present exposures no flint clays were observed and what plastic clays were seen look somewhat impure. Further prospecting might, however, bring to light some good-quality clays among these beds. At the east end of the section at Tyrone Mills, the Brush Creek coal is exposed and beneath it 6 feet of clay (No. 416).

Layton-Dickinson area on the Youghiogheny River. Where the Youghiogheny River crosses the Fayette anticline the Brush Creek member and the Allegheny group are well exposed in a deep gap. At Layton on the western flank of the anticline, strata of the Mahoning horizon are exposed and the clays extensively developed by the Layton Fire Clay Co. The section shows:

Feet	
10	Sandstone
8	Soft blue shale and clay (No. 401)
30	Concealed
10	Heavy sandstone
8	Semi-flint clay (No. 402)
10+	Cross-bedded sandstone

The two 8-foot beds of clays have been mined and the clay used for the manufacture of firebrick and paving brick. Paving brick is now manufactured from the upper bed of soft clay. The clay is molded in a Bucyrus machine, passed through represses and burned in 8 round kilns, coal-fired.

From Layton south to Dickerson the anticline brings up the entire Allegheny group and its coals and clays are exposed and available. In past years Bolivar and Lower Kittanning clays have been opened, but at present no good clays of working thickness are to be seen. Further prospecting might disclose any of the Allegheny group clays in this area.

West flank of Chestnut Ridge. The most active fire clay mining has been on the lower, western slope of Chestnut Ridge, from the Westmoreland County line southwest to beyond Fairchance. The clays lie either in the Brush Creek and Mahoning beds above the Freeport coal, or in the Bolivar bed, below the coal.

The Jos. Soisson Brick Company have worked plastic and flint clay at various places on the mountain east of Moyer. Shaw (1928) describes one in the vicinity of Heminger's Mills (now Mt. Olive Church) (analysis No. 26), made up of 2 feet of plastic clay underlain by 9 feet of flint clay. The mixture fuses at cone 30.

Another clay used by the Soisson plant is on Zacharias property in Tan Yard Hollow, just northeast of Connellsville. Here there is apparently no coal, the clay lying under 15 feet of sandstone and shale. The clay is good quality, about 9 feet thick, plastic, with flint clay lenses from a few inches to 3 or 4 feet thick. Mr. Shaw has tested this flint clay (No. 403). This clay and other openings to the north and east of Moyer are probably Bolivar clays. The Hatfield mine, east of Moyer, shut down in 1912, and the Zacharias mine in Tan Yard Hollow has not operated since 1929. From all of these small mines the clays were trucked to the railroad or to the Moyer plant.

Along the Tan Yard Hollow road, northeast of Connellsville, Geo. B. Shaw operates a coal mine, Upper Freeport (?), showing 15 feet sandstone roof, 2 feet coal, and 11 feet soft clay. Tests have been made on this clay (No. 404) by J. B. Shaw.

In South Connellsville, there are various outcrops of fire clay, either just above the Freeport coal or at the Bolivar horizon below it. These have been described by Shaw (1928). One mine owned by the Jos. Soisson Brick Co. north and half a mile east of the end of the trolley line in South Connellsville shows 10 feet of plastic clay under the Freeport coal (No. 29). It fuses at cone 32 and is a No. 1 fire clay. Another clay along the Baltimore & Ohio Railroad in South Connellsville is described as in the Lower Conemaugh group. It has been worked by the Soisson Company. It consists of 7 feet of plastic clay underlain by 4 feet of semi-flint clay (No. 27). The plastic clay fuses at cone 16, the semi-flint at cone 28. They have been used in making coke-oven brick and other low-heat duty refractories.

Farther south along the Youghiogheny River on either the Baltimore & Ohio or Western Maryland railroads, the Allegheny clays appear, including clays in the Bolivar, Lower Kittanning and Brookville horizons. None appear to be of much value.

Seven miles south along Chestnut Ridge near Mt. Braddock, the Eureka Fire Brick Company operates a firebrick plant, their clays coming from the ridge east of the plant. Two mines are operated, one a soft clay mine showing 10 feet of clay, the upper 2 feet of high grade; the other, a flint clay ranging from 3 to 8 feet thick. The soft clay is probably the Upper Kittanning (L. K., F. T. M.) and the flint clay Mahoning. The clay under the Upper Freeport is said to be limy and that under the Lower Kittanning (Brookville-Clarion, F. T. M.) sandy. Tests made by Shaw indicate that the flint clay fuses at cone 26 to cone 32 and it is classed as a good No. 2 clay. Sample No. 406 represents the average of the flint clay bed and No. 405 of the plastic clay.

The clays of the Eureka Company are trammed by rope haulage and steep incline to the plant. They are passed over a dry pan, through a Tyler screen and a wet pan. They are molded in a Freese machine and burned in a battery of 10 rectangular kilns. The production is chiefly coke-oven brick, mill brick and special mill shapes.

Southward along the ridge, east of Fairchance, the Fayette Fire Brick Company formerly made face brick and firebrick from a 10-foot bed of plastic clay classed by Shaw (1928) as Sharon clay (No. 33). This correlation is wrong and the clay is Mercer or Allegheny in age. According to Shaw, it had excellent burning qualities, uniform shrinkage and porosity and fused at cone 18. This would indicate a clay useful for face brick manufacture or as a bond in firebrick manufacture, but not a high-grade fire clay.

Farther to the south, near Wymps Gap, Stevenson (1878) records the mining of a Bolivar clay by Mr. Emme, the clay being shipped as a glass pot clay.

Ohiopyle Valley area. This area includes the synclinal area of Conemaugh and Allegheny rocks between the ridges from Champion and Indian Head, south through Ohiopyle and Farmington to Elliottsville. Beginning at the north end, the fire clay resources are as follows:

Just east of Roaring Run (Champion) Post Office old pits show from 4 to 6 feet of excellent flint clay probably of the Bolivar horizon (No. 413). One-quarter of a mile south of Indian Head along the railroad, plastic and flint clay are seen under Lower Kittanning coal. The section there shows the following:

Feet	
2	Sandstone
1	Sandy clay
1	Black shale
3	Rooty clay
10	Buff shale
20	Shale, well laminated
4	Coal, Lower Kittanning
1	Plastic clay
1	Flint clay (No. 415)
4	Plastic clay (No. 414)
2	Clayey sandstone

At this Indian Head locality it would seem possible to use the plastic clay alone or in connection with the flint clay for manufacture of various clay products, using the fire clays mixed with the shales above the coal. North of Normalville, on Poplar Run Road, 2 miles west of its intersection with Route 711, the Upper Freeport coal carries immediately beneath it a 7-foot bed of plastic clay (No. 412).

Between Normalville and Ohiopyle along the road there are many good exposures of the Allegheny group. One mile north of Bear Run along the road (Route 381) is an outcrop of flint clay underlying limestones. The section shows:

Feet	
—	Coal bloom
1	Shale
1	Dark limestone
5	Nodular limy flint clay
1	Buff shale
1	Dark limestone
2	Buff shale
4	Plastic clay with flint clay lenses (No. 410)

This is probably of the Bolivar clay horizon.

South of Bear Run 1½ miles and ¼ mile south of Three Maples School, the following section is exposed:

Feet	
10	Sandstone
2½	Coal (Upper Freeport)
5½	Clay (No. 418)
6	Brown shale
6	Sandstone

The clay is a plastic clay.

Along the road at the rear of the Ohiopyle Hotel appear clays just above the Brookville coal. There is about 10 feet of plastic and flint clay, the flint clay forming a very irregular lens in the plastic clay. The flint clay above was sampled by itself (No. 397), and a second sample (No. 398) was taken as a mixture of the plastic and the flint clays in the bank. If this bed on further prospecting should prove to be of regular thickness, its accessibility to the Baltimore & Ohio Railroad gives it good possibilities.

Along the railroads, both north and south from Ohiopyle, are good exposures of the Allegheny group and lower strata. North from Ohiopyle 2½ miles and half a mile north of Kaufmann Station (Bear Run), Jos. Soisson Fire Brick Co. formerly mined soft clay from 2 openings 75 feet above the Baltimore & Ohio Railroad. There is 6 to 8 feet of this clay overlain by 2 feet of coal (No. 407).

Three-quarters of a mile north of Kaufmann along the Baltimore & Ohio Railroad there is an outcrop of 5 to 10 feet of clay overlain by a thin coal. The section shows:

Feet	
—	Sandstone (Homewood)
4	Clay
6	Shale, brown
2	Cannel shale
6	Brown shale
1	Coal (Mercer)
5–10	Clay (No. 408)

This clay is to be seen for half a mile at rail level and has been noted across the river on the Western Maryland Railroad.

Just south of Stewarton and about 100 feet above the railroad is the old Frick clay mine with three openings. It would seem from these tests and from the former clay mines that there is an opportunity for further development of the clays along the Baltimore & Ohio and Western Maryland railroads north of Ohiopyle, especially the lower clay at rail level between Stewarton and Kaufmann. Along the road leading northwest from Ohiopyle, past Cucumber Falls, several clays are exposed, as will be seen by the section of the Allegheny group. The most interesting of these clays is a flint clay at the Bolivar horizon (No. 409). This clay is in a shale bed and the flint portion varies from 0 to 4 feet in thickness. The locality is one mile north of Cucumber Run bridge.

North of Elliottsville 2½ miles on the Wharton Furnace road, 8 feet of plastic clay (No. 417) under 6 feet of brown shale is exposed.

Fayette County fire clays

No.	Name	Location	Character and use	Fired color
26	Flint clay	4½ miles N. E. of Connellsville	No. 2 flint clay	
27	Semi-flint clay	Gibson (S. Connellsville)	A low-grade fire clay capable of being used for building brick and low-grade refractories	
28	Flint clay	Gibson (S. Connellsville)	No. 2 flint fire clay	
29	Plastic clay	South Connellsville	No. 1 plastic clay capable of producing No. 1 fire brick	
30	Plastic clay	2 miles S. W. of Connellsville	No. 3 fire clay used for production of refractories	
31	Flint clay	7 miles S. W. of Connellsville	No. 2 fire clay	
32	Plastic and flint clay mixture	7 miles S. W. of Connellsville	No. 3 fire clay	
33	Plastic clay	Fairchance	Fire clay successfully used for brick, etc.	
397	Brookville flint clay	Ohiopyle	A good quality flint clay, useful for the production of refractories	Light gray
398	Brookville plastic and flint clay	Ohiopyle	Suitable for face brick, hollow tile or low heat duty refractories	Buff to light gray
401	Mahoning soft clay	Layton Fire Clay Co.	A buff-burning clay, suitable for production of face brick or hollow tile	Cream to gray
402	Mahoning hard semi-flint clay	Layton Fire Clay Co.		Gray
403	Bolivar plastic and flint clay	Tan Yard Hollow	A good quality flint clay	Light gray
404	Upper Freeport plastic clay	Tan Yard Hollow	A buff-burning clay, useful for the production of face brick or hollow tile	Gray
405	Lower Kittanning plastic clay	Eureka Fire Brick Co., Mt. Braddock	Can be used in production of face brick, hollow tile or as a bond in fire brick manufacture	Buff to gray
406	Mahoning flint clay	Eureka Fire Brick Co., Mt. Braddock		Light gray
407	Plastic clay	Kaufmann Station	A No. 3 fire clay useful in the production of low-grade refractories or face brick	Buff to gray
408	Mercer clay	North of Kaufmann Station	A high-grade plastic fire clay useful for the production of refractories or building materials	Cream to gray
409	Bolivar flint clay balls	Cucumber Falls section	A high-grade flint clay	Light gray
410	Upper Freeport plastic and flint clay	North of Bear Run	A high-grade flint clay	Cream
412	Upper Freeport plastic clay	Poplar Run	A low-grade fire clay suitable for low heat duty refractories, a bond clay, or face brick manufacture	Cream to dark gray
413	Bolivar flint clay	Roaring Run		Gray
414	Plastic clay	Indian Head	A good quality plastic fire clay, suitable for refractories	Buff to light brown
415	Flint clay	Indian Head	A friable, weak flint clay of doubtful value	Very dark gray
416	Brush Creek fire clay	Tyrone Mills	A plastic fire clay useful for the production of low-grade refractories or structural clay products	
417	Plastic clay	2½ miles north of Elliottsville	A plastic fire clay useful for the production of refractories, face brick, or tile	Buff to gray
418	Upper Freeport plastic clay	Three Maples School	A high-grade plastic fire clay, useful for the production of refractories or building materials	Light buff to gray

Physical properties of Fayette County fire clays

Green and fired properties in percent

	Green properties		Fired properties									
			Volume shrinkage									
No.	Water of plasticity	Volume drying shrinkage	Cone	07½	05	02½	1	3½	6	8½	11	13½
			°C	1000	1050	1100	1150	1200	1250	1300	1350	1400
26	23.58	14.55		*3.07	4.18	6.31	7.93	8.18	8.15	11.08	7.27	6.00
27	17.46	12.97		.87	1.74	2.87	6.95	—	11.54	12.50	6.58	—7.45
28	19.73	10.75		2.17	3.86	5.39	8.47	8.52	9.86	6.06	6.95	10.23
29	21.49	19.59		6.11	11.47	8.40	13.00	—	19.78	21.82	15.00	14.45
30	18.92	11.41		4.49	5.42	5.18	6.73	—	14.36	18.28	8.17	4.22
31	21.48	12.26		8.28	10.60	11.32	—	14.09	15.00	13.40	14.86	13.55
32	21.42	14.83		3.29	—	8.09	9.63	13.02	13.72	14.70	9.74	4.13
33	21.42	14.83		.56	6.09	6.42	8.76	—	15.00	19.75	21.10	11.50

No.	P. C. E. (Fusion)			Porosity								
	Cone	°C	°F									
26	30	1670	3038	35.0	35.3	37.5	37.6	35.6	33.1	34.1	32.8	30.5
27	16	1450	2642	28.4	25.6	28.6	27.8	—	17.0	12.2	8.2	13.6
28	29	1650	3002	32.7	33.1	33.2	35.4	32.3	30.4	31.0	29.8	27.6
29	32	1705	3101	30.2	24.7	27.1	25.7	—	14.1	9.2	6.8	6.0
30	26	1600	2912	24.6	23.5	25.7	24.2	—	15.2	12.7	10.9	3.3
31	29	1650	3002	34.5	34.9	35.5	34.9	33.6	32.7	32.7	32.3	34.7
32	26½	1610	2930	28.9	26.9	29.4	27.5	—	20.7	19.2	14.3	8.6
33	18	1490	2714	33.5	30.6	31.8	31.7	—	19.9	11.4	7.2	6.7

Properties of clays

	Green properties		Fired properties										
			Volume shrinkage (percent)								P. C. E. (Fusion)		
Number	Plasticity rating	Linear drying shrinkage (percent)	Cone	04	02	1	3	5	7	9	11	Cone	°C	°F
			°C	1060	1125	1160	1170	1205	1250	1285	1325			
397	10	4				1.5	1.5	2.5	3.0	3.2	3.5	31	1680	3056
398	70	6.5		9.0	9.6	10.7	11.3	12.5	13.7			26	1595	2903
401	70	7		1.6	4.7	5.0	6.3	7.4	11.0	14.4		28	1615	2939
402	40	3				3.3	4.1	4.3	5.3	8.0	14.0	20	1530	2786
403	10	7				3.0	3.4	3.7	4.0	4.4	4.5	31	1680	3056
404	75	7		4.0	4.8	8.0	10.5	11.7	17.8	20.0		20	1530	2786
405	70	4		3.0	3.2	4.0	5.3	7.0	11.0	12.1		20	1530	2786
406	30	4				6.4	6.8	7.2	7.2	8.4	10.2	26	1595	2903
407	70*	7		9.3	9.4	14.0	14.5	14.6	16.9	19.4		28	1615	2939
408	75	7		6.4	13.0	15.2	17.6	19.2	22.4	24.0		31	1680	3056
409	10	4				3.5	3.5	4.3	4.5	4.6	4.7	32	1700	3092
410	10	5				5.0	5.0	5.0	6.5	7.4	7.9	32	1700	3092
412	70	4		0	8.6	9.6	10.0	11.9	14.7	19.4		28	1615	2939
413	10	3				10.9	10.7	10.7	11.0	11.6	12.4	31	1680	3056
414	75	5		3.0	3.5	8.0	10.6	14.2	15.7	16.0		30	1650	3002
415	20	2.5				0	.2	1.0	1.0	1.2	2.0	30	1680	3056
416	80	4		.6	1.3	2.4	4.0	5.4	9.0	10.2		29	1640	2984
417	80	8		13.0	13.5	14.7	15.0	16.2	18.5	22.0		28	1616	2939
418	90	8				18.6	23.0	26.6	27.5	28.7	29.0	30	1650	3002

Properties of clays—Concluded

Number	Fired properties in percent																	
	Absorption									Porosity								
	Cone	04	02	1	3	5	7	9	11	Cone	04	02	1	3	5	7	9	11
	°C	1060	1125	1160	1170	1205	1250	1285	1325	°C	1060	1125	1160	1170	1205	1250	1285	1325
397				16.6	16.6	16.8	17.0	17.0	17.3				27.4	27.4	28.4	28.5	28.5	28.7
398		20.0	19.0	18.3	14.0	12.5	10.0				37.0	36.5	33.6	28.6	25.0	22.9		
401		19.5	17.7	17.0	16.5	15.8	14.7	11.5			33.0	32.5	31.8	28.5	26.0	23.5	21.8	
402				6.8	6.0	5.2	3.4	2.9	2.4				20.0	18.5	14.8	9.8	8.8	7.5
403				10.8	10.7	10.0	9.8	9.5	8.8				22.2	28.6	28.2	27.3	26.8	26.3
404		13.7	13.6	11.9	11.2	10.6	7.3	6.4			37.0	36.1	33.0	32.6	32.1	22.8	21.3	
405		21.5	21.4	20.5	19.6	18.6	14.7	11.6			37.0	36.8	33.6	33.4	33.0	27.4	22.3	
406				15.7	15.0	14.5	14.2	13.8	12.0				27.4	26.5	25.3	24.6	23.0	22.4
407		18.0	17.6	13.7	12.0	10.7	7.9	6.3			34.2	29.5	26.3	23.7	21.6	20.0	19.0	
408		19.9	16.2	14.5	12.6	11.8	10.7	7.0			34.4	30.0	27.0	26.5	23.4	16.0	12.0	
409				18.3	18.0	17.6	17.7	17.6	17.0				28.4	28.4	28.0	26.5	26.4	26.3
410				18.6	18.5	18.5	17.3	17.2	17.0				30.4	30.4	30.2	28.9	27.7	27.7
412		15.0	11.1	10.7	9.8	9.7	9.3	9.0			24.6	22.6	21.1	19.6	17.0	16.7	10.0	
413				16.5	16.5	15.5	14.4	14.0	13.7				26.2	26.1	25.4	25.0	24.0	24.0
414		22.0	21.0	19.5	19.0	18.6	16.0	15.6			28.5	28.4	27.0	26.8	25.4	24.9	24.6	
415				25.5	25.5	24.9	23.8	23.7	22.9				34.5	34.2	33.7	32.6	32.0	31.4
416		17.2	16.8	15.5	15.0	14.7	12.3	8.3			30.0	29.7	26.4	24.2	23.7	21.6	19.0	
417		12.5	12.4	11.9	10.0	8.5	7.2	5.0			24.0	24.0	23.2	21.3	16.7	14.8	12.4	
418				11.1	8.5	4.3	.5	.4	.2				21.8	17.2	9.2	1.6	.9	.4

Chemical analyses of Fayette county clays

No.	Ign.	SiO_2	$Fe_2O.$	TiO_3	Al_2O_3	CaO	MgO	Ma_2O	K_2O	MnO	P_2O_5	SO_3
26	3.91	62.98	7.10	1.00	17.21	1.98	1.49	.83	2.05	.15	.21	.40
27	6.81	58.33	5.74	.72	24.14	2.02	1.09	.59	.92	.03	.04	.18
29	9.92	53.50	1.19	.07	29.45	1.42	.25	1.84	1.52	.27	.006	.50
31	12.50	52.80	.50		32.70	.18	.22					
33	5.95	64.18	4.43	1.09	19.72	.89						

LIMESTONE

Limestone ranks as one of the minor mineral resources of Fayette County. Although many quarries have been opened on numerous limestone beds, few of them are of commercial importance and the product of only two or three is shipped out of the county.

Uses of limestone

For a complete description of the uses of limestone and the properties required to fit the stone to any use, the reader is referred to Chapter VI of Prof. B. L. Miller's report on Limestones of Pennsylvania.[1] Brief descriptions of the uses which apply to Fayette County limestones will be given here.

Structural stone. Limestone is often used for building stone and paving blocks. In Fayette County, the Loyalhanna has been used for many years for making paving blocks and in a few cases curbstone has been produced. The requirements of a limestone that fit it for making pavements take no account of the chemical composition, but are based entirely on physical characteristics. The most important attribute is resistance to abrasion, which depends on a combination of hardness and toughness. Very hard tough limestone is most suitable for paving blocks. A second requirement is resistance to weathering, since any rock that weathers readily is unsuitable for stone paving blocks which in most cases are used outdoors. A third requirement is suitably spaced and regular fracture planes so that the stone may readily be broken into blocks of suitable shape and size. The fracture planes are commonly the bedding planes of the rock and one or two joint systems so arranged that all are at right angles to each other. The color of the stone used for paving blocks is of little importance but becomes highly important in stone used in the walls of buildings.

Crushed stone. Crushed limestone is used for railroad ballast, road aggregate and surfacing, and concrete aggregate. In certain other uses, such as cement rock, flux, etc., the limestone is crushed, but since the crushing is only incidental in the preparation for use they are not considered under crushed stone uses. The physical properties of the rock entirely determine its suitability for ballast and aggregate. The rock should be hard, tough, durable and sufficiently massive to break into angular fragments. Several of the Fayette County limestones fill these requirements, as will be seen below under the descriptions of individual beds, and three of them, Loyalhanna, Greenbrier and Benwood are at present quarried for crushed stone.

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[1] Miller, B. L., Limestones of Pennsylvania: Pennsylvania Topo. and Geol. Survey, Bull. M 20, pp. 77-110, 1934.

Pulverized stone. None of the Fayette County limestones is pulverized and even the fine screening from the crushing plants is not used. Pulverized stone is used as animal food, as filler for paints, cloth, etc., as limestone sand in concrete and plaster, for rock dusting in mines, and as agricultural fertilizer. It seems as though some of the product of the crushing plants in Fayette County might be put to some of these uses.

Lime. The only use for which Fayette County limestone is burned is as agricultural lime. A few small upright lime kilns have been erected in the county and are used part of the time, but by far the greatest quantity of lime is burned in heaps built up of alternate layers of limestone and coal. This method is very wasteful of fuel, but since coal is abundant and cheap in the county, and in many places is mined in country banks on the farm where it is burned, the wastefulness is not of great moment.

The requirements of limestone that fit it for making agricultural lime take little account of the physical properties but are based almost entirely on the chemical properties. A moderately high content of calcium and magnesium carbonate is essential, since if these constituents are low, impurities such as silica, alumina and iron oxide are high, and these impurities not only make the burning of the lime more difficult and costly, but also necessitate the handling of a larger quantity of material to produce the same effect on the soil.

Cement rock. No limestone is produced for cement rock in Fayette County at the present time but in the past a good natural cement was made from limestone quarried near Uniontown. Since portland cement has entirely supplanted natural cement, the revival of natural cement manufacture seems unlikely. However, since it might be possible to adapt several of the Fayette County limestones to the manufacture of portland cement by the addition of a small quantity of high-grade materials, or by some method of concentration of the desired constituents, a brief account will be given here of the requirement for this product.

In the manufacture of portland cement all the limestone requirements are based on its chemical composition. The chief ingredients should be $CaCO_3$ 75 percent, SiO_2 12-15 per cent, Al_2O_3 and Fe_2O_3 10-12 percent. $MgCO_3$ should not be over 5 per cent and preferably should be less. Alkalies and sulphates are determined but they are rarely present in limestone in sufficient quantities to warrant consideration. Several analyses of the Greenbrier limestone closely approximate the above figures and it is believed that this limestone might well produce cement rock of a desirable composition.

Chemical stone. Limestone is used for a great variety of chemical purposes, but only two are applicable to the Fayette County stone. Limestone was quarried many years ago for use as flux in the local iron furnaces which have since been abandoned, and the composition of many of the Fayette County limestones is such that they might be adaptable to the production of rock wool. The requirements for flux stone are largely chemical but hardness and breaking into angular fragments are helpful qualities in flux for a blast furnace. Chemically flux must be as nearly pure carbonate (either calcium or calcium-magnesium carbonates are suitable) as practical since the flux action is carried on entirely by the carbonates. The best requirements for rock wool have not been definitely determined as yet but suitable wool can be produced from rocks which have a 1:1 ratio of calcium and magnesium oxides compared with silica, alumina and iron oxide. Greater detail is given on rock wool compositions by B. L. Miller[1] and Fryling.[2] Many analyses of the Loyalhanna when compared with the charts and diagrams given by the Illinois Geological Survey show rock eminently suitable for rock wool.

Stratigraphic and areal distribution

Limestone occurs throughout the greater part of the strata of Fayette County. The highest strata of the county that have any areal extent are in the Washington group, which contains several limestones. From the base of the group upwards they are the Elm Grove, Mt. Morris, Colvin Run, Woodglen, Lower Washington, Blacksville, Middle Washington, Jollytown and Upper Washington limestones. The Monongahela group next below the Washington group is the most abundantly supplied with limestone of any in the county. The limestone strata of this group enumerated from the base upwards are named Redstone, Fishpot, Lower Benwood, Upper Benwood, Uniontown and Waynesburg limestones. Several of these beds are thick and in places divide into two or more parts. The Conemaugh and Allegheny groups, which lie below the Monongahela and constitute the lower part of the Coal Measures, contain many thin discontinuous beds of limestone. The limestones in the Conemaugh have been named Mahoning, Brush Creek, Cambridge, Woods Run, Ewing, Ames, Barton, Clarksburg, Lower and Upper Pittsburgh. The limestones of the Allegheny have been named Vanport, Johnstown, Lower and Upper Freeport. None of these attain a great thickness in the county and only a few reach 5 feet. Most of them are under 3 feet thick and are not of commercial importance.

In the lower strata of Fayette County the only limestones occur in the Mississippian. The Greenbrier limestone of the Mauch Chunk series and the Loyalhanna siliceous limestone lying between the Mauch Chunk and the Pocono are both well developed in the county. The Greenbrier, which is a fairly pure rock, ranges from 5 to 40 feet thick and is extensively quarried. The Loyalhanna, which ranges from nearly pure limestone to nearly pure sandstone, averages 50 to 60 feet thick and is opened by several of the largest quarries in the county. The Pottsville, Pocono and Devonian strata do not contain limestone where exposed in the county.

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[1] B. L. Miller, op. cit., pp. 101-104.

[2] Lamar, J. E., and Willman, H. B., Rock Wool. Part III. Chemical Investigations by C. F. Fryling. Illinois Geol. Survey, Bull. 61, pp. 159-204, 1934.

In the eastern part of the county on and east of Chestnut Ridge the chief limestones exposed are the Greenbrier and Loyalhanna but a few of the Allegheny and Conemaugh limestones also crop out. In the area east of Laurel Hill, the Ewing and Upper Freeport limestones have been quarried by farmers. Along the flanks of Laurel Hill and at its southern end where it plunges steeply north of the National Pike the Greenbrier has been quarried in a small way at many places. The Loyalhanna crops out throughout this same area, but at only two places south of the Youghiogheny River has any rock ever been taken out. Near Ohiopyle, Conemaugh and Allegheny limestones are quarried intermittently. In the Farmington-Elliottsville area the Cambridge limestone is mined along with the Lower Bakerstown coal which lies directly on top of it. In the Mill Run-Ohiopyle area the Upper Freeport limestone is quarried and along Indian Creek the Johnstown limestone is opened. Along Chestnut Ridge the Greenbrier and Loyalhanna are quarried extensively. The Greenbrier is opened in many places along the west bank of the ridge from Freed northeast of Connellsville south as far as Wymps Gap. On the east side the Greenbrier is opened in large quarries near the National Pike. The Loyalhanna is opened in several large quarries and mines on the west flank of Chestnut Ridge between Connellsville and Uniontown, and in a few small quarries on the east flank along the Youghiogheny River and near the National Pike.

West of Chestnut Ridge most of the limestone quarried comes from the upper part of the Coal Measures. In the Uniontown-Connellsville district all of the Monongahela limestones have been opened but most of the stone produced comes from the Benwood near Chadville and southeast of Buena Vista. Little limestone is produced along Brush Ridge, the only quarry noted being on the Ewing limestone near Waltersburg. In the Klondike district limestone production comes from several horizons in the Monongahela and Washington groups. In the area northeast of Brownsville most of the quarries are on the Benwood limestone but a few are on the lower limestones of the Washington group. Southeast of Brownsville the chief limestone production comes from the Upper and Lower Washington limestones, but the Uniontown, Benwood and Fishpot limestones also are quarried.

Description of individual strata and quarries

Only limestones of sufficient extent and thickness to be of economic interest will be discussed below. General data on the many thin and economically unimportant limestones are given in the section on stratigraphy in Part I of this report.

LOYALHANNA SILICEOUS LIMESTONE

Stratigraphic position. The Loyalhanna lies in the lower part of the rocks exposed in Fayette County and is the lowest known calcareous bed. Lying on the Burgoon sandstone of the Pocono it extends up to the basal red shales and sandstones of the Mauch Chunk. It is a part of the Mississippian system.

Character and thickness. The Loyalhanna is predominantly a homogeneous, massive, cross-bedded, sand and limestone with calcareous cement. Gray when fresh, it commonly weathers light gray, but in a few places, where the iron content is above the average, weathered surfaces are stained buff or yellow. Irregular masses of reddish material occur in the homogeneous gray rock. These are not related to the sedimentary structure but are connected with secondary silicification which has taken place in irregular patches throughout the formation.

The rock is composed predominantly of quartz grains and calcitic oolites cemented by calcite. It contains also a few rounded grains of crystalline calcite. The quartz grains, which range from 1 mm. to .01 mm., are distinctly frosted, and although distinctly subangular their points are rounded. Although all grain sizes between the limits mentioned above are found in the Loyalhanna, individual specimens are composed of grains falling into one or two size groups of narrow limits. If only one size of grain occurs in the specimen commonly it is within the limits .10 to .05 mm. Where grains of two sizes are present, the larger grains commonly lie within the limits .5 to .2 mm.; a few specimens showing grains larger than .5 mm. have a lower limit of .3 to .4 mm. for the coarse grains. The fine-grained part in these specimens ranges from .05 to .02 mm. but in few cases grains as small as .01 mm. were seen.

All the quartz grains do not appear to come from the same source. Most are unicrystalline quartz which has sharp extinction under crossed nicols. Others show undulatory extinction similar to that which is produced by strain, and still others show a multicrystalline structure similar to that found in recrystallized quartzites. Some of the quartz grains, quite irrespective of the types mentioned above, contain considerable dark staining material thought to be limonite. This stain is related to individual grains and not to areas in the rock and so must have been acquired by the quartz before its deposition in the Loyalhanna. Some quartz grains contain minute needles of apatite and one was seen with included zircon crystals; both minerals indicate an igneous source for this quartz.

Calcite grains and oolites are common in the Loyalhanna. The siliceous and calcareous content is quite variable and in rock which has a low siliceous content oolites are abundant. The oolites commonly are so stained with opaque material that the crystallinity of the calcite is not apparent, but in a few cases a radial structure was observed. Oolites are present in all thin sections of the rock but are abundant only in material that has less than 40 percent of insoluble residue. Rounded grains of clear unicrystalline calcite are present in some thin sections. The grains do not look like oolites but rather appear to be calcitic sand grains which have been included in the detritus that accumulated during the formation of the rock.

Besides the quartz and calcite mentioned above, tourmaline, biotite, chlorite, feldspar, olivine (?) and black opaque mineral grains were observed. The matrix cementing the grains of the rock is calcite in all the thin sections studied. In a few cases the calcite is contaminated with clayey material from partly altered biotite. Commonly, however, it is fairly pure and coarsely crystalline. None of the thin sections show silicification of the cement, although field examination of some of the material indicates the complete silicification of the carbonate in parts of the upper beds of the formation. The great variation in the calcareous content of the rock is due to the relative abundance of granular and oolitic calcareous material and not to variation in the cement.

Cross-bedding is the most striking feature of the Loyalhanna. Although it is nearly invisible on fresh surfaces, it stands out where a surface has been exposed long enough for weathering to emphasize the inequalities of the individual beds. These individual beds 0.1 to 1 inch in thickness form sequences that may be as much as 4 to 5 feet thick. These sequences are commonly cut off on each end at steep angles to the bedding by other sequences of similar extent and character. In many cases the bedding planes of individual sequences may be slightly curved. The greater part of the total Loyalhanna thickness is built up in this manner. The cross-bedding does not affect the usability of the rock for building stone as the difference between the beds is laregly one of grain size and not of composition, and the bedding planes are commonly not planes of fracture; thin irregularity therefore does not affect the size and shape of the blocks made from the stone.

A peculiar phase of the Loyalhanna was seen along the eastern flank of Chestnut Ridge a few miles south of Summit. At this point a cross-bedded sandstone was found directly below the red Mauch Chunk shale in the position normally occupied by the calcareous Loyalhanna. Since the cross-bedding of the sandstone is of the Loyalhanna type rather than the even-bedded, cross-bedding of the Pocono it seems more probable that this loosely cemented sandstone is the Loyalhanna without its calcareous cement. In other places where no outcrops of calcareous Loyalhanna have been found between the Mauch Chunk and the Pocono the Loyalhanna may not necessarily be absent from the section but may be represented by a cross-bedded sandstone too weak to form outcrops.

The thickness of the Loyalhanna is not easy to determine in most places because of the paucity of extensive exposures at its horizon but it seems to range from 40 to 70 feet and to average between 50 and 60.

Quarries and mines. The Loyalhanna is more extensively quarried and mined in Fayette County than any other strata except the Pittsburgh coal. Four principal quarries and several smaller ones have a combined yearly capacity of over a half a million tons of crushed stone. All the large quarries are on Chestnut Ridge near Connellsville or Uniontown.

The Opperman Bluestone Company operates a quarry (74)* along the Springfield Pike about 2 miles east of Connellsville. The quarry is on the south side of a small creek and faces north. The quarry face is parallel with the dip of the rocks which is about 10 to 15 degrees. The overburden thickens fairly rapidly back of the face and consists of Mauch Chunk sandstone and red shale. About 50 feet of gay homogeneous Loyalhanna is exposed in the quarry; the upper 15 feet is less massive than the lower 35 feet in which the rock is cross-bedded and contains some red layers and lenses. The product of the quarry is crushed stone sized to meet highway specification. The quarry has no railroad siding and the stone is shipped by truck. Analyses are given at the end of the section.

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* Numbers in parentheses represent locations on the geologic map of Fayette County accompanying this report.

The Vang Construction Company operates a mine (244) on the Loyalhanna at Casparis on the north bank of the Youghiogheny River in the gorge through Chestnut Ridge. The quarry was formerly operated by the Casparis Bluestone Company, then by the Youghiogheny Crushed Stone Company. The main office of the Vang Construction Company is in Pittsburgh. The large plant at Casparis employs 80 men when the plant is operating at capacity. All the equipment is electrically driven. Early operations were conducted in a quarry that is 600 feet above the river and has a face 80 to 100 feet high and many hundred feet long. Fifty-five feet of Loyalhanna are exposed in the quarry, above which lies Mauch Chunk sandstone and thin beds of red shale. The Loyalhanna lies nearly flat in the quarry because it is very close to the Chestnut Ridge anticlinal axis. When the overburden became too thick for economical quarrying, a mine was opened on the limestone behind the quarry face. Four entries parallel to each other, two extending back into the hill, 500 feet and two 1,000 feet are 50 to 55 feet high and 40 feet wide. They are joined at intervals so as to leave pillars 30 by 30 feet. The roof of the mine in part is the basal Mauch Chunk sandstone and in part the upper 5 feet of the Loyalhanna. An incline and rock chute lead from the quarry down to the Baltimore & Ohio Railroad along the Youghiogheny River where the stone is loaded for shipment. All the quarried material is crushed and the chief product is coarse crushed stone which is sold for railroad ballast. The finer material is sold for road metal and surfacing.

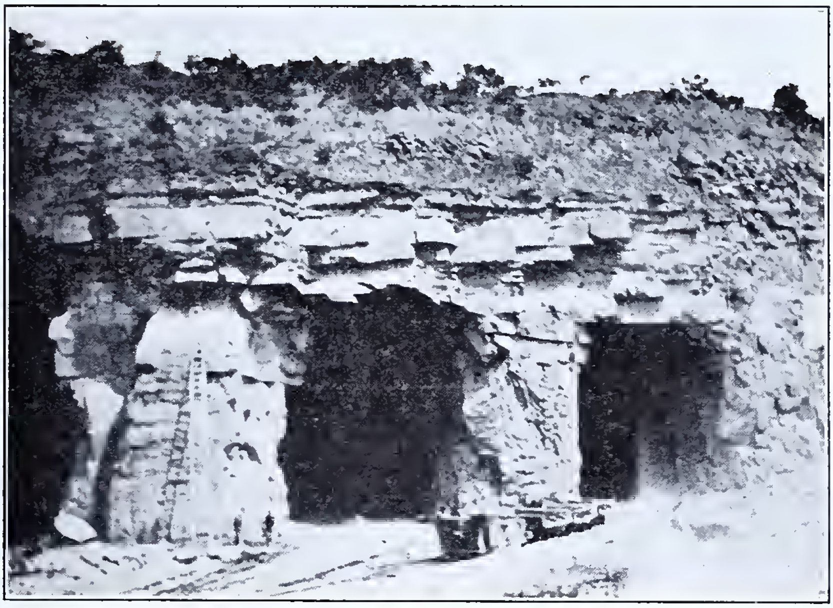

Figure 142. Vang Construction Co. mine in the Loyalhanna limestone 3 miles southeast of Connellsville.

The New Castle Lime and Stone Company of New Castle, operates a mine (239) on the Loyalhanna limestone 2 miles east of Dunbar on the north bank of Dunbar Creek. (See Fig. 4460.) An open cut quarry was worked along the outcrop 2,000 feet and back until the overburden became thick; then a mine was opened in the quarry face. The strata dip 10° NW. parallel to the face of the quarry. The mine openings are 45 feet high and 30 feet wide; the pillars left in mining are 40 by 40 feet. Three drifts are each about 1,000 feet long. The roof consists of the highest 5 to 10 feet of the Loyalhanna. The plant is on the New Haven & Dunbar Railroad which connects it with the Baltimore & Ohio, the Pennsylvania and the Pittsburgh & Lake Erie railroads at Connellsville. Paving blocks and crushed stone are produced. The crushed stone capacity is about 200,000 tons a year, most of which is used for highway stone, a little for railroad ballast. In 1929, 900,000 paving blocks were produced but the demand has fallen since to almost none.

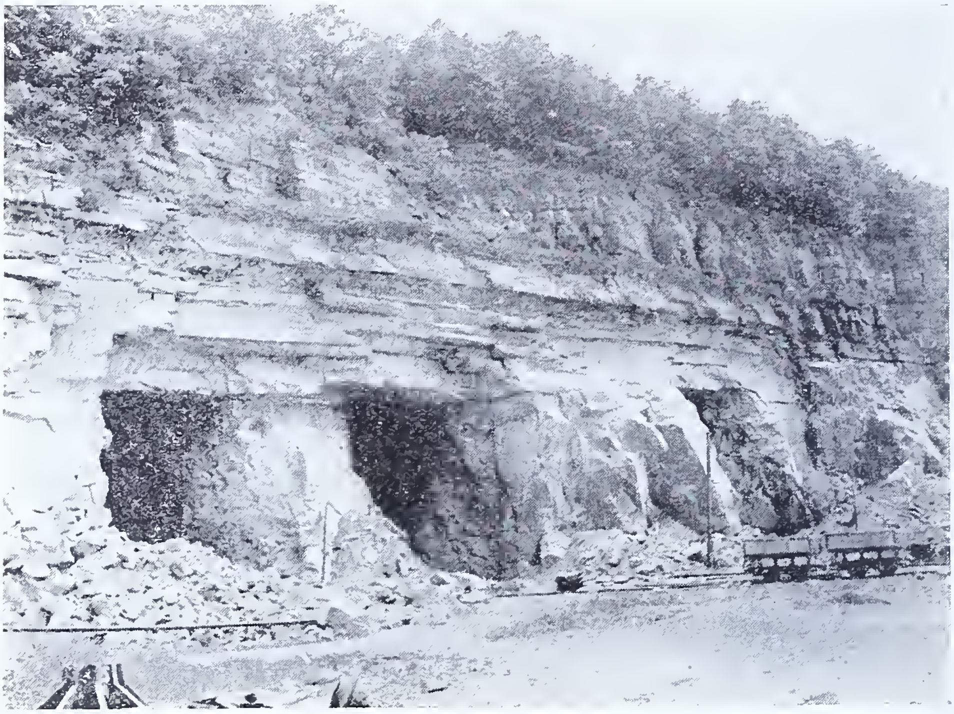

Figure 143. New Castle Lime & Stone Co. mine in Loyalhanna limestone near Dunbar (1934).

The Coolspring Bluestone Company operates a quarry (217) 1½ miles east of Coolspring. The strata strike N. 40° E. and dip about 15° NW. The quarry face is nearly parallel to the dip and the floor slopes steeply towards the northwest. Only about 30 feet of the lower part of the Loyalhanna are opened in the quarry, the upper part and the overlying Mauch Chunk having been removed by erosion. The plant has no railroad siding and the product is either trucked directly to the consumer or to the railroad 2 miles away. Paving blocks and crushed stone are produced. The paving blocks are dressed by hand on the quarry floor and the refuse from this operation is run through a crusher and sizer and sold for crushed stone to the local market. Many paving blocks are shipped considerable distances. Occasionally when the block business is poor, newly quarried stone is taken directly to the crusher.

Several quarries have been opened on the Loyalhanna in the past which have since been abandoned or, owing to inacessibility, have never reached a stage of extensive production. Short accounts will be given here of the more important of these. The Connellsville Bluestone Company, which operated a quarry (243) on the north bank of the Youghiogheny gorge through Chestnut Ridge about 1 mile east of the Vang Construction Company's mine, gave up operations several years ago when they were unable to convert their quarry into a mine because the roof would not hold up. The old quarry (243) has a face nearly 80 feet high and over 500 feet long. The face parallels the 10° NW. dip of the strata at the quarry. A Loyalhanna quarry (241) owned by the Dunbar Corporation was formerly operated by the Western Maryland Railroad Company when they built their railroad into Connellsville. It is high on the south bank of the Youghiogheny River where it cuts Chestnut Ridge. The quarry has been abandoned for several years and is largely overgrown. The product was used by the Western Maryland for track ballast. In a similar manner the Baltimore & Ohio Railroad many years ago operated a quarry (242) on the Loyalhanna where this formation dips down to its tracks along the Youghiogheny River on the western flank of Chestnut Ridge. The stone quarried here was reported used for track ballast and for fill along the river bank through the gorge where coarse, resistant rock was needed.

On Laurel Hill, the Loyalhanna has been quarried at two places in the past. Neither quarry is operating at present. The Standard Lime and Stone Company operated a commercial quarry on the hill above the Western Maryland Railroad southwest of Bidwell Station. Fifty feet of brown-gray siliceous limestone are exposed in the quarry under approximately 11 feet of Mauch Chunk red shale and brown sandstone. The other quarry (320), located on the J. H. Treacher farm, has not been operated for many years but produced much of the stone used in building the original National Pike which passes a short distance south of the quarry. The quarry face exposes 21 feet of siliceous limestone but does not represent the whole Loyalhanna. The lower part of the exposure is coarser than the upper, and in places in almost conglomeratic.

Loyalhanna limestone quarries in Fayette County.

No.	Township	Status	Owner
74	Connellsville	Commercial	Opperman Bluestone Co.
75	"	Inactive	J. L. Stader
76	Bullskin		S. S. Snader
217	North Union	Commercial	Coolspring Bluestone Co.
239	Dunbar	"	New Castle Lime and Stone Co.
240	"	Active	Dunbar Corporation
241	"	Inactive	" "
242	Connellsville	"	Baltimore & Ohio Railroad
243	"	"	Connellsville Bluestone Co.
244	"	Commercial	Vang Construction Co.
248	Wharton	Inactive	Mrs. Altman
291	Springfield	Active	
312	Henry Clay	Commercial	Standard Lime and Stone Co.
320	" "	Active	J. H. Treacher

Analyses. The Loyalhanna has been sampled at all the quarries mentioned above and at several other localities where it is exposed. Both chemical and physical analyses were made of the rock from some places, but from others only one or the other was obtained. The chemical analyses indicate its fitness for manufacturing mineral wool and other products, and the physical analyses are useful in determining the fitness for highway construction and other uses of crushed stone.

Chemical analyses of Loyalhanna siliceous limestone

	1	2	3	4	5	6	7
SiO_2	53.60	48.33	50.26	51.32	43.86	35.18	37.03
Al_2O_3	3.17	3.95	5.38	2.92	2.17	1.96	2.70
Fe_2O_3	2.29	1.76		.72	1.57	.83	.93
CaO	22.00	25.40	24.9	24.70	27.74		
MgO	.94	.87	Trace	.58	.58		
TiO_2	.20			.30	.20		
SO_3	Trace			Trace	1.76		
Loss on ignition	17.58			19.00	22.16		
$CaCO_3$	39.38			44.2	49.7	60.77	57.65
$MgCO_3$	1.97			1.21	1.21	.75	.66

Chemical analyses of Loyalhanna siliceous limestone

	8	9	10	11	12	13	14
SiO_2	41.77	35.68	21.46	45.58	49.50	50.95	30.10
Al_2O_3	2.86	2.78	1.96	3.59	3.50	3.71	2.92
Fe_2O_3	1.50	1.56	.60	1.09	1.14	1.25	.93
$CaCO_3$	49.53	58.37	74.82	47.71	43.94	41.73	64.22
$MgCO_3$	2.80	.70	.56	.73	.66	.73	.84

1. Vang Construction Co. (Youghiogheny Crushed Stone Co.) quarry (244). Composite. Analyst, Pittsburgh Testing Laboratory.
2. Vang Construction Co. (244). Composite. 8-18-30. Analyst, Forrest City Testing Laboratory, Columbus, Ohio.
3. Vang Construction Co. (244). Composite. 8-29-30. Analyst, Pittsburgh Plate Glass Co.
4. New Castle Lime and Stone Co. quarry (239) at Dunbar. Analyst, Pittsburgh Testing Laboratory.
5. Coolspring Bluestone Company quarry (217). Analyst, Pittsburgh Testing Laboratory.
6. Sample F-30. Opperman Bluestone Co. quarry (74). Analyst, Booth, Garrett and Blair.
7. Sample F-94. Mrs. Altman quarry (248). Analyst, Booth, Garrett and Blair.
8. Sample F-79. Outcrop, Wharton Furnace road ¼ mile south of National Pike, 15 feet at base of Loyalhanna sampled. Analyst, Booth, Garrett and Blair.
9. Sample F-98. Outcrop at base of Pondfield triangulation station 5 miles south of Summit on Chestnut Ridge. 10 feet at base of Loyalhanna sampled. Analyst, Booth, Garrett and Blair.
10. Sample F-96. Outcrop at triangulation station 5 miles south of Summit on Chestnut Ridge. 5 feet at top of Loyalhanna sampled. Analyst, Booth, Garrett and Blair.
11. Sample F-108-109. Road cut, Wymps Gap road 1.5 miles west of Wymps Gap. 20 feet at lower part of Loyalhanna sampled. Analyst, Booth, Garrett and Blair.
12. Sample F-100. Road cut ¼ mile north of Longwood School, Saltlick Township. 27 feet of massive Loyalhanna sampled. Analyst, Booth, Garrett and Blair.
13. Sample F-106. Ledge in field on J. A. Stroyer farm, 4 miles east of Mill Run. Analyst, Booth, Garrett and Blair.
14. Sample F-320. J. H. Treacher quarry (320). 21 feet at base of Loyalhanna sampled. Analyst, Booth, Garrett and Blair.

Physical analyses

[Analyst, Pennsylvania Department of Highways Testing Laboratory]

Sample No.	Sp. gr.	Weight lbs./cu. ft.	Absorption	Percent wear	French coef. of wear	Toughness
F-6	2.68	167.2	0.22	3.4	11.8	8
F-10	2.69	167.8	0.47	2.3	17.4	20
F-29a	2.66	166.0	0.34	2.4	16.7	15
F-29b	2.65	165.3	0.44	2.2	18.2	15
F-29c	2.66	165.9	1.65	3.9	10.3	11
F-30	2.69	167.9	0.25	2.6	15.4	8
F-52	2.69	167.8	0.48	3.4	11.8	8
F-118a	2.79	174.2	0.24	2.6	15.4	22
F-118b	2.74	171.0	0.39	2.8	14.3	17
F-135	2.68	167.2	0.28	2.4	16.7	16
F-143	2.65	165.4	0.46	2.5	16.0	14
F-145	2.63	164.1	0.34	2.4	16.6	13

All above are acceptable for all highway construction.

F-6.	Road cut in upper Loyalhanna, 1.3 mi. west of Wymps Gap. Fifteen feet sampled.
F-10.	Quarry (217), Coolspring Bluestone Co. Quarry sample.
F-29.	Quarry (244), Vang Construction Co. Quarry samples.
F-30.	Quarry (74), Opperman Bluestone Co. Quarry sample.
F-52.	Quarry (239), New Castle Lime and Stone Co. Quarry sample.
F-118a.	Quarry (243), Connellsville Bluestone Co. Quarry sample.
F-135.	Quarry (241) owned by the Dunbar Corporation and operated by the Western Maryland Railroad. Quarry sample.
F-143.	Quarry (75), J. L. Stader. Quarry sample.
F-145.	Outcrop on S. S. Snader land, 2 mi. east of Connellsville.

Uses. At present the Loyalhanna sileceous limestone is quarried for both macadam and concrete, for highway resurfacing, and for railroad ballast. A small part of the output goes into general concrete building construction. It is well suited for all these uses, as can be seen from studying the physical tests recorded above. They show a very low percentage of wear, and good toughness, which are of value in stone to be used on a road surface where there is considerable abrasion. The low absorption is an additional advantage in that it retards the weathering of the stone. The same qualities make the stone suitable for railroad ballast.

It has been suggested that the Loyalhanna would serve well as a raw material in the manufacture of rock wool. The chief requirements of stone for rock wool are chemical and for this reason several chemical analyses were made of samples from scattered localities in the county to see if the Loyalhanna in general is suitable for rock wool manufacture. The Illinois Geological Survey has studied the types of rock which are suitable for rock wool manufacture and has published diagrams (pp. 192-198)* which show the permissible amounts of magnesia, alumina and lime that may go with specific percentages of silica to produce rock wool. These diagrams show certain of the characters that will be produced in the rock wool by specific mixes of these four ingredients. The silica content of the available Loyalhanna analyses ranges from 53.6 to 21.4, but half of the analyses are grouped around 40, 45 and 50 percent silica. The Illinois diagram for 45 percent silica content shows that suitable rock wool can be made from rock containing roughly 20 to 45 percent lime, 0 to 20 percent magnesia and 10 to 20 percent alumina. If we compare these limits with the available analyses, the alumina (with which can be included the iron oxide) is low; otherwise the analyses show the Loyalhanna eminently suitable. It would be very simple to rectify this lack of alumina by the addition of a small amount of shale which is available in great abundance.

The diagram for 50 percent silica shows that in order to make good rock wool the lime content can vary from 20 to 45 percent, alumina from 0 to 15 percent and magnesia from 0 to 20 percent. With this higher percentage of silica, less alumina becomes necessary and all the analyses which contain 48 or more percent silica are rock which would be suitable for the manufacture of mineral wool without the addition of any material. Consequently it may be said in general, that the more siliceous parts of the Loyalhanna limestone are suitable in themselves for the manufacture of rock wool, whereas the less siliceous parts would require the addition of small amounts of shale or sandstone.

Caves. Three caves are known in Fayette County. All are in the Loyalhanna limestone. Barton Cave, 4½ miles west of Elliottsville on the head of Quebec Run, is about 400 feet long. Casparis Cave, about 2 miles south of Connellsville on the east side of Youghiogheny River, is about 300 feet long. Dulany Cave, the largest known cave

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* Fryling, Charles F., Rock Wool. Part III. Chemical Investigations. Illinois Geol. Survey, Bull. 61, pp. 159-204, 1934.

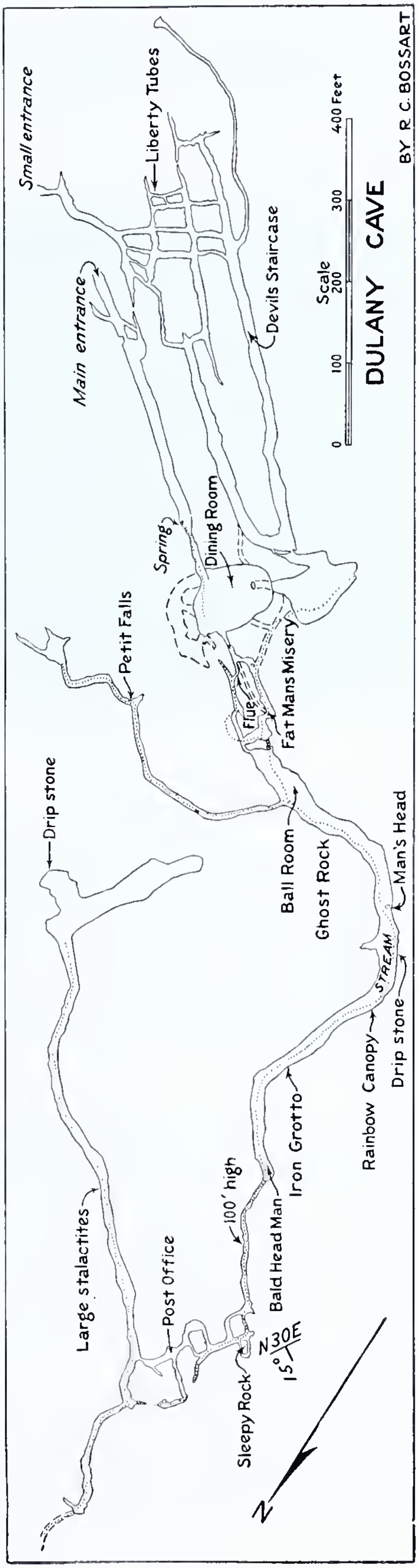

Figure 144. Map of Dulany Cave.

in the State, is 5 miles south of the Summit Hotel on Chestnut Ridge. More than a mile of passages have been mapped. The limestone dips 15° and the lowest point in the cave is 2,000 feet from the entrance and 300 feet lower.[1]

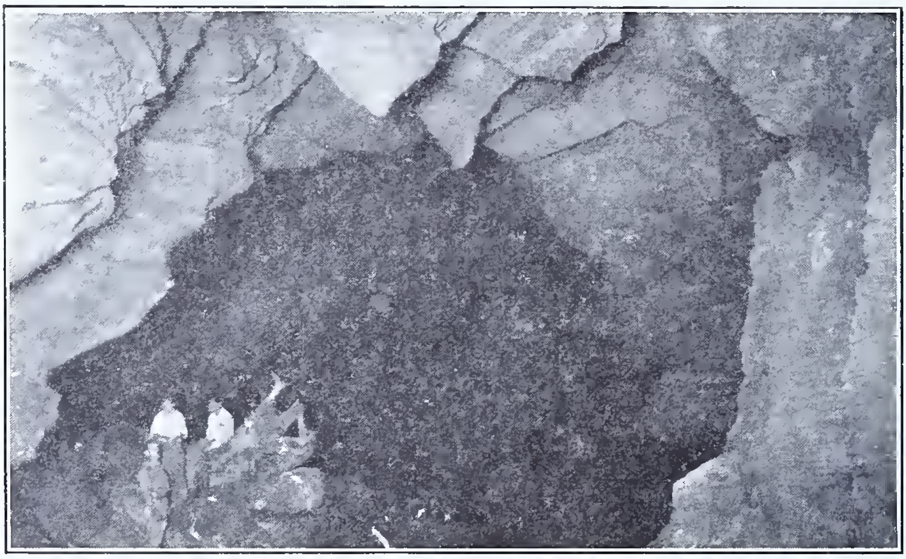

Figure 145. Ball Room, Dulany Cave.

GREENBRIER LIMESTONE

Stratigraphic position. The Greenbrier limestone lies near the base of the Mauch Chunk series and is separated from the underlying Loyalhanna siliceous limestone by 10 to 50 feet of red shale and brown sandstone. It is separated from the overlying Pottsville formation by the upper part of the Mauch Chunk series which consists in Fayette County of approximately 150 feet of red and green shales, interbedded with buff to brown micaceous cross-bedded sandstones. In age the Greenbrier is Mississippian and either Ste. Genevieve or lower Chester.

Character and thickness. The Greenbrier limestone is a dark, blue-black fossiliferous limestone in thick massive beds. Near the top it is interbedded with gray calcareous shales which may form up to 50 percent of the strata. Occasional thin shaly beds occur in the lower part of the Greenbrier. The limestone beds are composed of many small fossil shells and shell fragments cemented together with finely crystalline calcite. One thin section shows a few very fine quartz grains. Certain horizons show an abundance of moderate-sized unbroken shells.

The Greenbrier limestone ranges in thickness from 5 to 40 feet. It is thinnest along the northern border of the county and thickest southward, reaching a maximum in the Wymps Gap region. In the northeast corner of the county on Laurel Hill, 5 feet of Greenbrier is exposed in the George Pritts (284) quarry. The limestone, which at this point contains no interbedded calcareous shale, is overlain and underlain by red shale. At the Meade Mountain quarry (294), which is on Mud Pike where it crosses Laurel Hill, there is 10 feet of massive limestone underlain by red sandy shale. In the Beaver Creek school area 13 feet of Greenbrier is exposed. It is believed that the section in the Ed Hensel (319) quarry does not represent the whole thickness of the Greenbrier because incomplete sections in near-by exposures show 15 to 20 feet. In the vicinity of Freed on Chestnut Ridge, which is the northernmost exposure of the Greenbrier along the anticline, 9 feet of limestone is exposed with about one foot of calcareous shale at the top. Southward along Chestnut Ridge the limestone thickens so that near Connellsville 10 feet of massive limestone is exposed with limestone and calcareous shale on top. At Uniontown the limestone is 35 feet thick, the upper 10 feet being interbedded gray limestone and brown shale; and in the Wymps Gap area at the south end of Chestnut Ridge 20 feet of massive limestone is exposed, overlain by at least 15 feet of interbedded limestone and calcareous shale.

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[1] Stone, R. W., Pennsylvania Caves: Pa. Topog. and Geol. Survey Bull, G 3, pp. 68-75, 1932.

Quarries. The Greenbrier limestone is opened in more than 50 quarries along Chestnut Ridge and Laurel Hill. Most of these quarries are merely small openings from which one or two farmers extract enough limestone for liming their fields and are operated only a few days out of the year. Such quarries will not be described in detail in this report, but a table will be given below that will show by townships the ownership and status of the quarries. A few of the larger quarries that have been extensively worked in the past, or that are operated at present on a large scale will be described briefly below.

The Sam Harshman quarry (70), 1 mile northeast of Breakneck, Bullskin Township, is a moderately-sized quarry in steeply dipping Greenbrier. Ten feet of dark blue, massive, fossiliferous limestone is exposed striking approximately northeast and dipping 15° NW. In the last few years this quarry has operated only part of the time and produced limestone which is burned in an unright kiln at the quarry and sold to nearby farmers for agricultural purposes. An abandoned crushing and screening plant of small capacity has been used to produce crushed limestone for highway surfacing.

The North Union Township Stone Quarry Company's quarry (220) is on the north side of the National Pike about 1 mile east of Hopwood, North Union Township, on the west flank of Chestnut Ridge.

The limestone strikes approximately northeast and dips 20 to 25° NW. A section measured at this quarry shows

	Ft.	in.
Red shale	3	
Interbedded red and green shale and limestone (limestone stained red and green)	3	
Gray limestone	2	6
Gray limestone and shale	1	6
Gray to greenish shale	1	6
Massive, blue limestone, fossiliferous	9	
Thin limestone and shale		6
Massive, blue, fossiliferous limestone	8	
Concealed		

Owing to the steep dip of the limestone and the position of the quarry in respect to the highway and the hill, the overburden rapidly becomes very great as quarrying advances. This greatly limits the output. All the limestone quarried is crushed and screened and used for highway surfacing.

The Greenbrier limestone quarry, Wharton Township, owned by J. V. Thompson (249) is north of the National Pike at the eastern base of Chestnut Ridge. This is the largest Greenbrier quarry in the county but has not been operated for several years.

	Ft.	in.
Surface clay passing downward into green shale	3	6
Massive bed of hard limestone	1	8
Greenish, fossiliferous shale with thin streaks of limestone	2	0
Thick-bedded limestone	4	0
Dark-colored shale	1	6
Thick-bedded limestone	22	0
Argillaceous limestone	0	6

The limestone strikes approximately northeast and dips about 10° SE. Much of the stone was used in surfacing near-by sections of the National Pike. See Figure 15.

Greenbrier limestone quarries in Fayette County

No.	Township	Status	Owner
70	Bullskin	Commercial	Sam Harshman
71	“	Active	James Keefer, R. D. 1, Box 84, Normalville
73	Connellsville	“	W. D. McGuinnes
77	“	Inactive	John Bruno
218	North Union	Inactive	
220	“ “	Commercial	North Union Township Stone Quarry Co.
238	Dunbar	Inactive	Dunbar Corporation (formerly operated by B. & F.)
245	Connellsville		Unknown
246	South Union	Inactive	South Union Township
249	Wharton	Commercial	J. V. Thompson
250	“	Active	Geo. Jackson
265	“	Prospect pit	Geo. Clare
267	“	Inactive	John Gooseman
268	“	Active	Mrs. Mary Martin
269	“	“	Lee Hunnell
273	Bullskin		Harry Wingrove
274	“	Inactive	James Stoffer
275	“	“	Jim Willtrout
276	“	“	Harry Brown
277	“	“	Mathew Kozac
280	Saltlick		Amos Critchfield
281	“	Active	Mrs. T. F. King
282	“	“	J. M. Pinkey
283	“	Inactive	Frank Berrier
284	“	Active	Geo. Pritts
285	“	Inactive	Sam R. Gerry and Geo. Pritts
286	“	“	John Adams
287	“	“	Schmuck Heirs
288	“	Prospect pit	Sam Solomon
289	“	Inactive	Miller & Wetsel
290	“	Active	Henry Bumgard
292	Springfield	“	A. G. C. Sherbondie
293	“	Inactive	Irving Mountain
294	“	Active	Meade Mountain (operated by Meyers)
295	“	Inactive	O. Harbaugh
296	“	Active	J. A. Schroyer
297	“	Active	“ “ “
298	“	Inactive	Cass Mountain
299	“	“	Stanton Bowers
300	“	Active	Ben Sipe
301	“	“	Frank Younkin
302	“	“	Sam Schroyer
303	“	“	“ “
307	Stewart	Inactive	Kimmel Silbaugh
308	“	Active	A. N. Sarver
309	“	Inactive	Calvin Rechnor
310	“	“	Harvey Marston
311	“	Active	John Liston
315	Henry Clay	“	Levi Stuck
316	“ “	Inactive	Harry Leonard
317	“ “	Active	C. W. McClain (Uniontown)
318	“ “	Inactive	John Shinkle (2 quarries)
319	“ “	Active	Ed Hensel
321	“ “	“	Dennis & Humbertson
322	“ “	“	Freeman Osler

Analyses. The Greenbrier limestone has been sampled at representative quarries throughout the county and at a few other outcrops where no quarries were available. In a few cases, both chemical and physical analyses were made of the rock, but most analyses are physical as it was desired to know the suitability of this rock for highway construction.

Chemical analyses of Greenbrier limestone

[Analyst, Booth Garrett and Blair]

Sample No.	S-8	S-9	F-151	F-66	F-105	F-84
SiO_2	14.63	8.36	13.86	8.14	6.38	11.96
Al_2O_3	3.59	2.55	4.12	3.25	1.79	4.38
Fe_2O_3	1.68	1.31	1.93	1.39	1.56	2.07
$CaCO_3$	75.46	84.37	75.27	82.55	85.15	77.09
$MgCO_3$	2.06	1.62	2.53	2.73	3.53	2.38
Total	97.42	98.21	97.71	98.06	98.41	97.88

S-8. Geo. Jackson quarry (250), Wharton Township, Wharton Furnace road ¼ mile south of National Pike; 8 feet at top of Greenbrier exposed.

S-9. Mrs. Mary Martin (268), Wharton Township, just north of the road through Wymps Gap; 9 feet of limestone sampled.

F-151. North Union Township Stone Quarry Co. (220), North Union Township, 1 mile east of Hopwood along National Pike; 17 feet of limestone sampled.

F-66. Sam Harshman quarry (70), Bullskin Township, 1 mile northeast of Breakneck; 11 feet of limestone sampled.

F-105. Meade Mountain quarry (294), Springfield Township, along the Mud Pike, 3 miles east of White Bridge; 8½ feet of limestone sampled.

F-84. Ed Hensel quarry (319), Henry Clay Township, ¼ mile northeast of Beaver Creek School; 9 feet of limestone sampled.

Physical analyses of Greenbrier limestone

[Analyst, Pennsylvania Department of Highways Testing Laboratory]

Sample No.	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness
				Percent	French coef.	
F-4	2.69	167.8	0.67	4.5	8.9	13
F-5	2.70	168.5	0.57	5.2	7.7	7
F-65	2.73	170.4	0.56	3.8	10.5	6
F-66	2.70	168.5	0.16	4.4	9.1	6
F-105	2.72	169.7	0.39	3.5	11.4	5
F-120	2.73	170.3	0.72	5.6	7.1	11
F-139	2.73	170.5	0.55	5.5	7.2	9
F-147	2.66	165.9	0.10	1.9	21.0	—
F-151	2.66	165.9	0.32	5.0	8.0	11
F-153	2.70	168.4	0.17	3.1	12.9	13
F-155	2.66	165.7	0.35	2.2	17.9	—

F-105, F-120 and F-139 are acceptable only for native stone base construction; the others for all highway construction.

F-4. Lee Hunnell quarry (269), ½ mile east of Wymps Gap, Wharton Township; 20 feet of limestone sampled.

F-5. Road cut ½ mile west of Wymps Gap, Springhill Township; 10 feet of limestone sampled.

F-65. James Stauffer quarry (275), ¼ mile west of Stauffer School, Bullskin Township; 15 feet of limestone stamped.

F-66. Sam Harshman quarry (70), 1 mile northeast of Breakneck, Bullskin Township; 15 feet of limestone sampled.

F-105. Meade Mountain quarry (294), Springfield Township, 10 feet sampled.

F-120. South Union Township Stone Co. (246) on Lick Run, 1 mile southeast of Hopwood, South Union Township; 25 feet sampled.

F-139. J. V. Thompson quarry (249), ¼ mile east of Summit on National Pike, Wharton Township; 22 feet of limestone sampled.

F-147. Booth & Flinn quarry (238) 1½ miles east of Dunbar, Dunbar Township; 10 feet of limestone sampled.

F-151. North Union Township Stone Co. quarry (220), North Union Township; 15 feet of limestone sampled.

F-153. Ed Hensel quarry (319) 1 mile south of Beaver Creek School, Henry Clay Township; 12 feet of limestone sampled.

F-155. John Bruno quarry (77) 2½ miles east of Connellsville on the Springfield pike, Connellsville Township.

Uses. The Greenbrier limestone is crushed for road surfacing and burned for agricultural lime. The chemical analyses above show that the limestone is too impure for chemical use and lime made from it is likewise too impure for any use except agricultural lime. The physical analyses show that the Greenbrier limestone from 8 localities is suitable for all types of highway construction, but three samples were not acceptable for road surfacing material, and therefore not all the Greenbrier quarries produce stone which can be used on highways. The use of the Greenbrier limestone for native stone base construction is not practical because cheaper and more easily quarried sandstones suitable for this purpose are at hand anywhere in the county.

JOHNSTOWN LIMESTONE

The Johnstown limestone lies between the Middle and Upper Kittanning coals of the Allegheny group and is commonly separated from the Upper Kittanning by the Upper Westernport sandstone.

The Johnstown limestone is gnarly and impure, with a medium to dark color; it is lacking in most parts of Fayette County, but along Indian Creek above Normalville its presence was noted at the surface and in several diamond drill holes. It has a maximum thickness slightly over 10 feet and an average thickness of less than 5 feet. Stevenson[1] records the presence of a limestone in the vicinity of Springhill Furnace west of Chestnut Ridge, which he calls Ferriferous (Vanport). However, it seems more probable that this limestone is the Johnstown and here it has a thickness of about 5 feet and has been opened in a few small quarries which at present are caved.

The Wesley Miller quarry (278) on the Johnstown limestone is on the east side of Route 711, 1¼ miles north of Indian Head in Saltlick Township. The quarry exposed about 10 feet of limestone, but has not been used for some years, and most of the face is caved. All the limestone quarried here was burned for agricultural lime and used on near-by farms.

UPPER FREEPORT LIMESTONE

The Upper Freeport limestone lies near the top of the Allegheny group, 10 to 15 feet below the Upper Freeport coal and above the Bolivar fire clay.

Where present the Upper Freeport limestone is a sporadic 3- to 5-foot bed of fresh-water limestone. It may be in one or more beds, 12 to 18 inches thick, separated by thin bands of clay. It is light gray and very hard and structureless, breaking with a conchoidal fracture. The only outcrops of this limestone noted in Fayette County lie east of Chestnut Ridge along the northern part of the Ohiopyle Valley and at the southern end of Laurel Hill.

None of the Upper Freeport quarries are of importance in Fayette County, but the limestone has been opened in several places where it is burned for agricultural lime. A list of the quarries is given below:

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[1] Pa. 2d Geol. Survey, Rept. KKK, p. 141.

Upper Freeport limestone quarries in Fayette County

No.	Township	Status	Owner
279	Saltlick	Inactive	Sagamore Coal Co.
304	Stewart	Active	C. B. Friend
324	Henry Clay	Inactive	Clister heirs
325	" "	Active	John A. Fike

No chemical analyses of this limestone are available but physical analysis was made of the stone from the C. B. Friend quarry (304), 3 miles south of Mill Run, Stewart Township, by the Pennsylvania Highway Department Testing Laboratory. Sample F-131, representing 6 feet of limestone, gave specific gravity 2.55, weight pounds per cubic foot 150.1, absorption 2.11, percent of wear 6.3, French coefficient 6.4, and toughness 8. This rock is acceptable only for native stone base construction.

MAHONING LIMESTONE

The Mahoning limestone lies between the Lower and Upper Mahoning sandstones at the base of the Conemaugh group, and where they are developed, between the Middle and Lower Mahoning coals.

The Mahoning limestone commonly is merely nodules in plastic clay, but at a few localities in Fayette County it develops into a thin and locally persistent bed. It is a fine-grained, gray, massive limestone which breaks with a conchoidal fracture and is not known to contain fossils.

The only place in Fayette County where this limestone is sufficiently well developed to warrant quarrying is in Wharton Township in the vicinity of Elliottsville and Gibbon Glade. The limestone has been opened in three places here. The steepness of the topography and the fact that the limestone crops near the valley bottoms necessitated mining, rather than quarrying. All three mines were caved when visited so that exact descriptions are not possible. The mines numbered 264, 271 and 272 on the map were opened respectively by J. P. Gleason, E. T. Tuttle and John Mass.

So far as known this limestone has only been used for agricultural purposes.

CAMBRIDGE LIMESTONE

The Cambridge limestone lies directly above the Buffalo sandstone and below the Lower Bakerstown or Thomas coal. The Cambridge limestone in an earlier report of southwestern Pennsylvania is commonly referred to as the Pine Creek limestone and is called the Thomas limestone in the Maryland report. The name Cambridge comes from Ohio and has precedence.

The Cambridge limestone in Fayette County is non-fossiliferous, hard, massive, light-colored and structureless, breaking with a conchoidal fracture. In this respect it is different from the usual dark, crystalline, fossiliferous Cambridge limestone of southwestern Pennsylvania.

The Cambridge limestone is mined extensively in the south end of Ohiopyle Valley between Farmington and Elliottsville. As it is only 2 feet thick, it is quite probable that this limestone would not be mined except for the fact that it lies directly below a 2-foot coal which is also recovered in the mining operation. Of eleven quarries seen, ten were active.

Cambridge limestone quarries in Wharton Township, Fayette County

No.	Owner	No.	Owner	No.	Owner
252	Mrs. Alex Scott	257	Ora Hager	261	Rishel & Van Brennan Co.
253	Paul Workman	258	Van Sickel Farm		
254	Wm. H. Shaffer	259	Richel Farm	262	Indian Creek Coal & Coke Company
255	Dr. Geo. Magee	260	Bearent Farm		

Because of the extent of limestone mining in the Farmington-Elliottsville area, a chemical and physical analysis have been made. Sample F-90 represents 28 inches of bed and was collected at the Van Sickel farm (258), 2¼ miles northeast of Elliottsville, Wharton Township.

Chemical analysis of Cambridge limestone

[Analyst, Booth, Garrett and Blair]

SiO_2	6.01
Al_2O_3	1.28
Fe_2O_3	1.50
$CaCO_3$	87.16
$MgCO_3$	1.89
Total	97.84

A physical analysis of this limestone by the Pennsylvania Department of Highway Testing Laboratory gave specific gravity 2.69, weight per cubic foot 167.9 pounds, absorption 0.35, percent of wear 4.1, French coefficient 9.8, and toughness 6. This stone is acceptable for all highway construction.

The Cambridge limestone is burned for agricultural lime for use on the surrounding farms. The thinness of the beds and inaccessibility preclude its use for highway stone, even though it is suitable.

EWING LIMESTONE

The Ewing limestone in the Conemaugh group lies directly on top of the Pittsburgh red beds and beneath the Harlem coal. It is a contorted, irregularly bedded, dark massive limestone which ranges from 5 to 10 feet in thickness, and bears traces of carbonized plants. The limestone is known in two widely separated parts of Fayette County in the Confluence-Somerfield region, and along the Fayette anticline in the vicinity of Waltersburg.

Three quarries have been opened in the Ewing limestone, none of which have produced much stone. They are the Sanford Black quarry (149) in Menallen Township, and the O. G. Butler (313) and J. A. Butler (314) quarries in Henry Clay Township.

Ewing limestone in Fayette County has been used only for making agricultural lime.

REDSTONE LIMESTONE

The Redstone limestone lies directly under the Redstone coal and is separated from the upper Pittsburgh sandstone by several feet of shale. It is composed of 2-foot beds which in places are separated by limy shale partings a few inches to a foot in thickness. The limestone is homogeneous, light to dark gray, hard and structureless, breaking with a conchoidal fracture. The total thickness including shale partings ranges from 0 to 20 feet and averages about five feet in the Klondike district, and fifteen feet in the Uniontown-Connellsville basin.

A few quarries have been opened on the Redstone limestone in Franklin, Menallen and Bullskin townships, all in the northern part of the county. None of them are particularly large or important quarries. All were active when visited.

Redstone limestone quarries in Fayette County

No.	Township	Owner	No.	Township	Owner
62	Bullskin	Adam Lillock	148	Menallen	John Dunn
103	Franklin	Luella Parkhill	150	"	Wm. John Campbell
105	"	Credo Coal & Coke Co.	196	Springhill	Wm. Drew, outcrop only

Although the Redstone is not an important limestone, its 15 feet of thickness in the Uniontown-Connellsville basin is sufficient to make it worthy of investigation and two chemical analyses and four physical analyses have been procured.

Chemical analyses of Redstone limestone

Sample	F-63	MM-594
SiO_2	7.16	
Al_2O_3	0.71	.81
Fe_2O_3	2.23	3.58
$CaCO_3$	73.06	66.47
$MgCO_3$	15.14	17.71
Insoluble		9.46
S		.08
P		.05

F–63. Adam Lillock quarry (62) 2 miles southeast of Kifertown, Bullskin Township. 4 feet sampled. Analyst, Booth Garrett and Blair.

MM–594. Lemont Furnace quarry, near Lemont Furnace, North Union Township. Analyst, A. S. McCreath (1879 p. 289). Analysis (recalculated) made years ago and quarry location in doubt and therefore it was not possible to check that stratigraphy. The main quarries furnishing flux to the Lemont Furnace are Fishpot in age and this analysis may represent Fishpot rather than Redstone limestone.

Physical analyses of Redstone limestone

[Analyst, Pennsylvania Department of Highways Testing Laboratory]

Sample No.	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness	Soundness
				Percent	French coef.		
F-63	2.71	169.1	1.01	3.4	11.8	10	O. K.
F-154	2.62	163.5	.67	4.7	8.5	11	
F-140	2.67	166.6	1.16	4.0	10.0	12	
F-70	2.63	164.1	1.93	3.7	10.8	8	O. K.

All acceptable for all highway construction.

F-63. Adam Lillock (62), 2 miles southeast of Kifertown, Bullskin Township. 6 feet of limestone sampled.

F-154. Outcrop on the Wm. Drew farm, ¼ mile north of Morris Cross Roads, Springhill Township. 4 feet of limestone exposed.

F-140. John Dunn quarry (148), 1½ miles northwest of Waltersburg, Menallen Township. 5 feet of limestone exposed.

F-70. Credo Coal & Coke Co. quarry (105) ½ mile east of Buena Vista, Franklin Township. 8 feet of limestone sampled.

The chemical analyses show a fairly pure limestone with a moderate magnesium carbonate content. However, the purity of this limestone is not sufficient to warrant its use for any process requiring high-grade limestone and the only chemical use is for the manufacture of agricultural lime. The physical tests on this limestone show it to be suitable for highway construction, and although it is not used for road surfacing at present, it would meet the requirements of such use and would make a fine road surface.

FISHPOT LIMESTONE

The Fishpot limestone lies in the lower part of the Monongahela group, directly below the Lower Sewickley coal, and is separated from the Redstone coal by several feet of shale. The Fishpot limestone is called the Sewickley limestone in the West Virginia reports. It is a hard, gray, homogeneous rock in 1- to 3-foot beds of massive limestone separated by thin shale partings. It breaks with a conchoidal fracture and resembles closely all the other Monongahela limestones. It is a single bed in the Brownsville area, but in the Uniontown basin it is separated into two parts by coal, clay and black shale. In the Klondike district it ranges from 10 to 30 feet in thickness, and averages a little better than 20 feet in all the mine shafts that cut this horizon. In the Uniontown-Connellsville district, the lower part of the limestone is present in all sections and ranges from 6 to 17 feet in thickness with an average of approximately 12 feet. The upper bench of the limestone is less persistent, being present in only three-quarters of the section, where it averages about 10 feet thick and is separated from the lower bench by 10 feet of coal, clay and black shale.

The Fishpot limestone is opened in a few quarries in Upper and Lower Tyrone, Dunbar, North Union, Georges, Menallen and Redstone townships. See Figure 27.

Fishpot limestone quarries in Fayette County

No.	Township	Status	Owner
44	Redstone	Active	Jos. Bosek
57	Lower Tyrone	Inactive	Geo. Cochran (Dawson)
60	Upper Tyrone	Active	W. H. Rankin
61	“ “	“	Frank Bell
91	Dunbar	Inactive	O. H. Shallenberger
92	“	Active	O. H. Shallenberger
156	Menallen	Inactive	Nelson Kern
182	Georges	“	Al. Brown, Jr.
204	North Union	Active	Mike Sabatula
213	“ “	Inactive	H. C. Frick Coal & Coke Co.
214	“ “	Prospect pit	C. W. McClain

A. S. McCreath, chemist for the Second Pennsylvania Geological Survey, analyzed the Fishpot limestone near Olyphant Furnace where it was formerly used as a flux in the old charcoal furnace. This analysis is given here, as it is the only one available. Three physical analyses have been made by the Highway Department of this limestone to determine its suitability for highway construction.

Chemical analysis of Fishpot limestone from Oliphant Furnace, Georges Township

[Analyst, A. S. McCreath (1879, p. 287)]

$CaCo_3$	80.648	SO_3	.052
$MgCO_3$	2.217	P_2O_5	.066
$FeCO_3$	1.657	H_2O	1.010
FeS_2	1.125	Insoluble	10.770
Al_2O_3	.543		

Physical analyses of Fishpot limestone

[Analyst, Pennsylvania Department of Highways Testing Laboratory]

Sample No.	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness	Soundness
				Percent	Fr. coef.		
F-56	2.69	167.9	0.78	3.8	10.6	9	O. K.
F-54	2.67	166.6	0.57	3.7	10.8	9	O. K.
F-8	2.72	169.7	1.98	3.7	10.8	22	O. K.

All acceptable for all highway construction.

F-65. George Cochran quarry (57), 1 mile north of Dawson, Lower Tyrone Township. 12 feet of limestone sampled.

F-54. O. H. Shallenberger quarry (91), ½ mile east of Vanderbilt, Dunbar Township. 10 feet of limestone sampled.

F-8. Road cut, 1 mile northeast of New Geneva, on State road to Smithfield. 7½ feet of limestone sampled. 2½ feet are interbedded limy shale not sampled.

The physical tests of the Fishpot limestone show that in every case the stone is suitable for all highway construction, but since the interbedded shale is not suitable, some difficulty might be experienced in quarrying. The limestone at present is used only for agricultural purposes in Fayette County, but the high lime content of the stone as shown in the chemical analysis makes it suitable for a low-grade flux where better-grade material is not available. It is unlikely that the limestone will be used for flux in Fayette County, because with the abandonment of the old charcoal furnaces, iron smelting has ceased in the county, and the stone is not good enough to be shipped any distance for this use.

BENWOOD LIMESTONE

Stratigraphic position and subdivisions. The Benwood limestone of the Monongahela group lies directly on top of the Upper Sewickley coal and is separated from the overlying Uniontown limestone by the Arnoldsburg sandstone. The Benwood limestone is divided into two parts throughout Fayette County by the Benwood black shale and coal horizon which in many places is comparable to the Benwood sandstone.

Character and thickness. The Benwood limestone is composed of 2- to 5-foot beds of massive, dark gray, homogeneous limestone, separated 1 to 10 feet by shale and clay partings. In many places the clay partings are very sandy. The limestone itself is massive and structureless, similar to the rest of the Monongahela limestones. The upper and lower divisions of the Benwood limestone are approximately equal in thickness, averaging about 50 feet each, including the interbedded sand, clay and shale.

Quarries. The Benwood limestone occurs throughout the western part of Fayette County and has been opened in more quarries than any other limestone, including the Greenbrier. The total production from these quarries, however, is not as great as for the Loyalhanna. Most of them are small, inconsequential quarries producing lime for use on one or two farms. Therefore, a few of the more important quarries will be described below, followed by a list of the less important.

The Harvey Elliot quarry (22) is on the Lower Benwood limestone about 4 miles northeast of Brownsville. About 15 feet of the limestone is exposed in this quarry and further working will probably increase the exposed thickness. The quarry face is about 100 feet long, the strata lie nearly horizontal, and the quarry is so situated that it can be greatly enlarged. An upright kiln at the quarry burns all the limestone produced to agricultural lime.

The Norman Piersoll quarry (18) is opened on the Upper Benwood limestone about 2 miles south of Star Junction, Perry Township. The quarry face is nearly 200 feet long, extends around the hill and exposes the following section. The limestone dips about 10° N.W. This quarry is so situated that by extending the length, large tonnages of limestone can be made available.

Piersoll quarry			Arnold quarry		
	Ft.	in.		Ft.	in.
Brownish gray limestone	3		Gray limestone	1	9
Clay		6	Thin limestone and clay beds	1	6
Light gray limestone		6	Gray clay shale		10
Clay		3	Brownish-gray limestone	3	
Blue clay limestone	1		Shale	1	
Green shale		10	Blue-gray limestone	2	
Dark gray limestone	1	6	Bottom concealed by water		

The J. W. Arnold quarry (102) is on the Lower Benwood limestone one mile southeast of Buena Vista. The section above is exposed in the quarry.

The limestone here dips 3° to 5° SE. This quarry is in a field behind the Arnold farm house and was opened by digging straight down. The pit has not reached the bottom of the limestone at this point and the surface cover above the limestone consists of a few feet of soil and clay. The quarry may produce large tonnages of limestone.

The Shady Side Coal Company quarry (188) owned by Robert Shaw is 1.7 miles south of Chadville on Route 119; it lies on the west side of the road and exposes 6 feet of limestone, with one inch of gray shale in the middle and 3 inches of gray shale 2 feet above the floor.

The strata are horizontal at this quarry, as it is very close to the Uniontown synclinal axis. Although the limestone is not thick, large tonnages can be produced at this quarry, as the limestone underlies several acres of ground with only 1 to 2 feet of soil cover. A small crushing plant in the quarry produces crushed limestone for highway surfacing. The limestone is quarried and burned on nearby farms to produce agricultural lime.

Benwood limestone quarries in Fayette County.

No.	Township	Status*	Owner
1	Washington	I	Pittsburgh Coal Co.
5	Perry	A	A. M. Fuller
6	“	A	“ “ “
7	“	A	“ “ “
17	“	I	Eckert Coal & Coke Co.
18	“	A	Norman Piersoll farm
19	“	A	M. E. Townsend
21	Jefferson	I	Grace Wood
22	“	A	Harvey Elliott
33	Franklin	A	J. Q. Adams
34	“	A	Washington Coal & Coke Co.
36	“	I	G. E. Allen
58	Upper Tyrone	A	Joe Oppweiser
63	“ “	A	Shaffer farm
65	Bullskin	A	Wm. Jainer
66	“	A	Calvin Minor
79	Connellsville	A	Margaret Banks
80	“	I	H. C. Frick Coal & Coke Co.
83	Dunbar	I	Anna E. Work
84	“	I	Mrs. Lillie White
87	“	I	F. C. Leighty
88	“	A	Harry Herbert
89	“	A	Bill Bartlow
90	“	A	Martin Maligucy
99	Franklin	A	Alvin Franks
100	“	I	
101	“	I	Sharosky
102	“	A	J. W. Arnold
104	“	A	H. C. Frick Coal & Coke Co.
106	“	A	Mrs. Bill Moore
107	“	A	John Bradley
108	“	A	Mrs. Bill Moore
109	“	A	James Lynn
110	Luzerne	I	Alfred Swan
112	“	I	J. R. Van Kirke
127	“	I	J. V. Thompson
147	Menallen	A	McCormick
154	“	A	Joshua Scott
155	“	I	Nelson Kern
162	South Union	I	Wm. Henshaw
163	“ “	I	“ “
183	Georges	A	R. B. Hayes
184	“	I	Ferd Sweeney
185	“	I	Robt. Shaw or Shady Side Coal Co.
186	“	I	Mrs. James Smiley
187	“	I	Frank & Marchant Robinson
188	“	C	Robt. Shaw or Shady Side Coal Co.
189	“	I	Mrs. James V. Robinson
190	“	A	Robt. Shaw or Shady Side Coal Co.
191	“	A	Minerva Moore
198	Franklin	A	Frank Remback
202	North Union	P	W. H. Bryson
203	“ “	I	W. H. Bryson
205	“ “	I	Fred and John Pocratsky
206	“ “	I	Miller Allton
207	“ “	I	“ “
208	“ “	I	Jacob Rozak
212	“ “	I	H. C. Frick Coal & Coke Co.
229	Dunbar	A	Robert Cense
230	“	I	“ “
231	“	A	“ “

* A, active; I, idle or inactive; C, commercial; P, prospect.

Analyses. Several chemical and physical analyses have been made of the Benwood limestone in connection with this report to determine its suitability for highway construction.

Chemical analyses of Benwood limestone

[Analyst, Booth, Garrett and Blair]

Sample No.	F-18	F-46	F-71
SiO_2	5.62	9.26	10.64
Al_2O_3	.92	3.06	2.18
Fe_2O_3	1.68	1.68	1.96
$CaCO_3$	83.78	77.35	78.00
$MgCO_3$	6.51	6.72	4.37
	98.51	98.07	97.15

F-18. Upper Benwood, Robert Shaw quarry (188), Georges Township, 1.7 miles south of Chadville. 4 inches clay rejected, 6 feet sampled.

F-46. Upper Benwood. Norman Piersoll quarry (18), 3 miles south of Perryopolis, Perry Township, 6 feet of limestone sampled. 1½ feet interbedded clay rejected.

F-71. Lower Benwood. J. W. Arnold quarry (102), 1 mile southeast of Buena Vista, Franklin Township. 6½ feet sampled, 3½ feet interbedded shale rejected.

Physical analyses of Benwood limestone

[Analyst, Pennsylvania Highway Department Testing Laboratory]

Sample	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness	Soundness	Remarks
				Percent	Fr. coef.			
F-146	2.68	167.2	0.20	3.5	11.4	12		A
F-71	2.69	167.9	0.77	4.2	9.5	5	O. K.	B
F-40	2.68	167.2	1.10	3.7	10.8	10	O. K.	A
F-60	2.70	168.5	0.32	3.0	13.3	5		B
F-46	2.66	166.0	2.41	3.9	10.3	10	O. K.	A
F-150	2.71	169.1	0.32	2.9	13.8	14		A
F-51	2.67	166.6	0.82	4.2	9.5	5	O. K.	B
F-133	2.67	166.6	0.10	3.2	12.5	16		A
F-18	2.59	161.6	0.98	4.5	8.9	9	O. K.	A

A—Acceptable for all highway construction.

B—Acceptable only for native stone base construction.

F-146. W. H. Wilkey farm; deep railroad cut exposes thick Benwood limestone, 2 miles southwest of Connellsville, Dunbar Township.

F-71. J. W. Arnold quarry (102), 1 mile southeast of Buena Vista, Franklin Township. 13 feet of dark blue limestone exposed.

F-40. Harvey Elliott quarry (22), 2 miles southwest of Redstone, Jefferson Township. 12 feet of limestone exposed.

F-60. Calvin Minor quarry (66), 3 miles south of Connellsville, Bullskin Township. 10 feet of limestone exposed.

F-46. Norman Piersoll quarry (18), 1½ miles south of Star Junction, 6 feet of limestone sampled, 1½ feet of interbedded shale rejected.

F-150. Mrs. James Smiley (186), 1½ miles south of Chadville, Georges Township. 5 feet of limestone exposed.

F-51. Robert Cense quarry (229), 1 mile west of Dunbar, Dunbar Township. 8 feet of limestone sampled.

F-133. Mrs. James V. Robinson quarry (189), 4 miles south of Chadville, Georges Township. 6 feet of limestone exposed.

F-18. Robert Shaw quarry (188), 7 miles south of Chadville, Georges Township. 6 feet of limestone sampled, 4 inches of clay shale rejected.

Uses. The greatest use in Fayette County of the Benwood limestone is for agricultural lime, for which it is eminently suitable. Quarrying on a small scale locally makes it easy to separate the massive limestone beds from the interbedded clay. In the past this limestone has been used as flux for the charcoal iron furnaces in Fayette County, but this use ceased with the death of this industry. It seems doubtful if the limestone will ever again be used as flux, because (1) it contains considerable silica which detracts from its use as a flux; (2) it is situated some distance from the furnaces; (3) better limestones are available in large quantities closer to the furnaces. A growing use is developing in Fayette County for this limestone as road surfacing material on the secondary roads being built in the county. The physical analyses listed above show that a good percentage of the limestone is suitable for all highway purposes. Therefore whereever a quarry is so situated that it can produce moderate to large tonnages of the limestone without too much intermixed shale, it should be examined to see if it is suitable for highway surfacing.

UNIONTOWN LIMESTONE

The Uniontown limestone lies in the Monongahela group directly under the Uniontown coal and is separated from the Benwood limestone by the Arnoldsburg sandstone.

The Uniontown limestone is a light to dark-gray, massive, homogeneous limestone which breaks with a conchoidal fracture. It averages about 15 feet thick in the western part of the county. If often contains interbedded shale and clay which normally form only a small part of the limestone, but in several places comprise nearly the whole thickness.

Few quarries have been opened on the Uniontown limestone because of the presence of the thick Benwood limestone directly below it in the stratigraphic section. The Uniontown limestone quarries are in Dunbar and Menallen townships, and include the inactive quarry of F. C. Leighty (86) in Dunbar Township, and the active quarries of Newton Hibbs (152) and E. F. McClelland (153) in Menallen Township.

Two chemical analyses given for the Uniontown limestone represent an upper and a lower bed. These beds were analyzed because most exposures of the limestone in Fayette County show a distinct upper and lower bed.

Chemical analyses of Uniontown limestone

[Analyst, Booth, Garrett and Blair]

Sample No.	F-27a	F-27b
SiO_2	9.59	5.57
Al_2O_3	2.40	1.08
Fe_2O_3	2.83	1.31
$CaCO_3$	76.18	79.95
$MgCO_3$	5.78	10.60
Total	96.78	98.51

F-27a. E. F. McClelland quarry (153), ¼ mile north of Dearth, south of National Pike, Menallen Township. Upper 4 feet of yellowish and sandy limestone sampled.
F-27b. Same quarry. Lower 3 feet of pure gray-blue limestone sampled.

Physical analyses of Uniontown limestone

[Analyst, Pennsylvania Highway Department Testing Laboratory]

Sample	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Soundness	Toughness
				Percent	Fr. coef.		
F-149	2.69	167.8	0.40	3.2	12.5	13	O. K.
F-15	2.64	164.7	3.57	4.7	8.4	10	
F-27	2.69	167.8	0.99	2.8	14.3	11	

All are acceptable for all highway construction.

F-149. Outcrop on the Poorhouse Farm, 2 miles west of Uniontown road; cut exposes 5 feet of limestone.

F-15. Newton Hibbs quarry (152), ½ mile east of Searights, Menallen Township; 10 feet of limestone sampled.

F-27. E. F. McClelland quarry (153), ¼ mile north of Dearth, Menallen Township; 10 feet of limestone exposed.

The Uniontown limestone is quarried for agricultural lime. No other use has been made of this limestone, but the physical analyses show that it would be suitable for all highway construction and some of the quarries are so situated that moderate tonnages could be extracted for this use.

WAYNESBURG LIMESTONE

The Waynesburg limestone is near the top of the Monongahela group, above the Uniontown sandstone and below the Waynesburg coal. The Waynesburg limestone in the Uniontown-Connellsville district occurs in one bench, but in the Klondike district it is separated into two benches by 10 to 15 feet of soft sandstone which is in part limy. See Figure 30.

The Waynesburg limestone is similar to the other Monongahela limestones, gray, massive, hard, and breaks with a conchoidal fracture. It occurs in 1- to 3-foot massive beds separated by 1- to 5-foot shale beds. In the Connellsville district it is 15 feet thick, whereas in the Klondike district the lower bench is 15 feet and the upper bench 6 feet in average thickness.

Few quarries have been opened on the Waynesburg limestone in Fayette County owing to its proximity to the very thick Benwood limestone.

Waynesburg limestone quarries in Fayette County

No.	Township	Status	Owner
39	Redstone	Prospect pit	Michael Waldron
228	Dunbar	Active	Bell Farm
210	North Union	Inactive	John Mathews
211	" "	Active	Geo. Freeman

No chemical analyses of the Waynesburg limestone are available, but two physical analyses have been made by the Department of Highways.

Physical analyses of Waynesburg limestone

[Analyst, Pennsylvania Highway Department Testing Laboratory]

Sample	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness	Soundness
				Percent	Fr. coef.		
F–11	2.67	166.6	0.45	4.0	10.0	Poor	O. K.
F–50	2.70	168.5	0.99	3.7	10.8	6	O. K.

F–50 is acceptable for all highway construction, and F-11 is not acceptable for any highway construction.

F–11. Outcrop steep hill bank, 2 miles north of Masontown, German Township; 10 feet of limestone sampled.

F–50. George Freeman quarry (211), ½ mile southwest of Mount Braddock, North Union Township; 5 feet of limestone sampled.

The Waynesburg limestone has been used only for agricultural lime. It is doubtful whether it would be suitable for highway material, as can be seen from the physical analyses. Furthermore, the interbedded clay-shale makes quarrying it for crushed stone impracticable.

MOUNT MORRIS LIMESTONE

The Mount Morris limestone lies beneath the Waynesburg "A" coal and above the Waynesburg sandstone of the Washington group. In the Uniontown-Connellsvile district it occurs as a single bench, but in the Klondike district there are two benches separated by a few feet of sandstone.

The Mount Morris limestone is dark blue-gray, homogeneous, and massive, and is interbedded with shale. In the Uniontown-Connellsville district the limestone averages 8 feet in thickness, whereas in the Klondike district the lower bench is 4 feet thick and the upper bench 3 feet.

COLVIN RUN LIMESTONE

The Colvin Run limestone of the Washington group lies above the Waynesburg A coal and below the Woodglen limestone, which is separated from it by several feet of shale.

The Colvin Run limestone is light-gray, homogeneous, and massive in most places, but a few outcrops show it as merely limestone balls in clay. The greatest thickness seen was 12 feet and the average thickness about 5 feet. It was not observed in the Uniontown-Connellsville district, although its horizon was exposed at a few places.

A prospect pit (29) was opened on the Colvin Run horizon 1 mile southwest of Woodglen in Jefferson Township.

Physical analyses of Colvin Run, Middle and Upper Washington limestone

[Analyst, Pennsylvania Highway Department Testing Laboratory]

Sample	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness
				Percent	Fr. coef.	
F–43	2.64	164.7	1.51	4.0	10.0	6
F–13	2.78	173.6	0.67	3.6	11.1	19
F–38	2.69	164.8	1.29	4.0	10.0	7

Soundness in right and all are acceptable for all highway construction.

F–43. Baptisto Cordero quarry (29), 1 mile southwest of Woodglen, Jefferson Township; 6 feet of limestone sampled. Colvin Run.

F–13. Wm. E. Lincoln farm in gully south of house, 3 miles south of Merrittstown, Redstone Township; 6 feet of limestone sampled. Middle Washington.

F–38. Wm. H. Grible quarry (139), 1 mile southwest of Brier Hill, Redstone Township; 10 feet of limestone sampled (lower 6 feet gray, upper 4 feet black). Upper Washington.

The Colvin Run limestone has been quarried at only one place; there it was burned for agricultural lime. Although this limestone is suitable for all highway purposes as shown by the test F-43, its extent and thickness are so limited in Fayette County that it is doubtful if it will ever be produced for crushed stone.

WOODGLEN LIMESTONE

The Woodglen limestone lies not far below the Waynesburg B coal, from which it is separated by the lower Mannington sandstone, and not far above the Colvin Run limestone, from which it is separated by shale.

The Woodglen limestone is a gray, homogeneous, massive limestone which breaks with a conchoidal fracture and lies in 1- to 2-foot beds separated by a few inches of clay. The Woodglen is more persistent than the other limestones in the lower part of the Washington group in Fayette County and is well exposed at several places in the northern part of the Klondike district. It varies from 0 to 9 feet in thickness, and averages about 7 feet.

The Woodglen limestone has been opened in two places. In Jefferson Township Hugh Murphy has an active quarry (31), and in Redstone Township Elizabeth Sharpneck has a prospect pit (42).

This limestone is quarried for use as agricultural lime. No tests are available to show whether it would be suitable for highway construction.

LOWER WASHINGTON LIMESTONE

The Lower Washington limestone is close to the top of the Washington coal and is separated from the lower Marietta sandstone by the Washington rider coal. It is a massive, light-gray, hard, structureless limestone in beds 2 to 3 feet thick separated by a few inches to 2 feet of shale. It is persistent in the Klondike district and, in connection with the Washington coal which underlies it, forms an excellent horizon marker for the middle of the Washington group. Its thickness ranges from 2 to 17 feet, with an average of 10 feet.

The Lower Washington limestone has been opened in 3 quarries. Two in Redstone Township (134, 135), one active and one inactive, are owned by Edward Hibbs. A third (2) in Washington Township on the S. L. Krepps farm, is inactive.

The Lower Washington limestone is quarried for use as agricultural lime. It might be suitable for highway purposes. No chemical or physical tests were made.

MIDDLE WASHINGTON LIMESTONE

The Middle Washington limestone lies 20 feet above the Washington A coal, from which it is separated by the Upper Marietta sandstone, and below the Davistown sandstone. It is extremely variable in character, being composed of several 1- to 2-foot beds of massive, gray limestone which are interbedded with considerable thicknesses of shale, sandy clay and coal. This coal is very lenticular in habit and does not form part of any persistent coal bed of wide extent.

An outcrop of this limestone on the Wm. E. Lincoln farm was sampled and has been tested to determine its suitability for highway use. See test F-13 in the table above.

Although not quarried, this limestone is suitable to burn for agricultural lime, and as shown by the physical analysis is satisfactory for all highway construction.

UPPER WASHINGTON LIMESTONE

The Upper Washington limestone at the top of the Washington group lies above the Brier Hill sandstone and below the Dunlap sandstone of the Greene group. It is composed of hard, massive, light or dark gray to black limestone beds 1 to 3 feet thick interbedded with 6-inch to 2-foot beds of gray, calcareous shales. In thickness it ranges from 5 to 20 feet, with an average of slightly over 15 feet.

This limestone has been quarried in Redstone Township by Frank Rice (137), Wm. H. Grible (139, 140) and Wm. E. Lincoln (145), and in German Township by Wm. Moore (166). All these quarries were active when visited.

Chemical analysis of Upper Washington limestone

[Analyst, Booth, Garrett and Blair]

SiO_2	11.21	$CaCO_3$	82.03
Al_2O_3	2.76	$MgCO_3$	2.00
Fe_2O_3	1.57		
		Total	99.57

F-38. William H. Grible quarry (139), 1 mile southwest of Brier Hill, Redstone Township; 7½ feet limestone sampled, 3 feet of interbedded shale discarded.

The Upper Washington limestone is quarried to burn for agricultural lime. The physical analysis shows that it would also be suitable for all highway construction, but it is possible that the difficulty in separating the limestone from the interbedded calcareous shales might preclude its use for this purpose.

SANDSTONE

Uses of sandstone

Sandstone is used in many ways, but only those for which it is quarried in Fayette County will be discussed here. In addition, a few notes may be given about the uses to which sandstone has been put in past years, but which are inactive at present, as it seems possible that these uses may again be of importance. The chief uses to which sandstone is put in Fayette County are glass sand, silica refractories, building, flagstone, crushed stone, natural stone base for roads, and miscellaneous uses, including molding sand and sand for sand blasting.

Glass sand. At the present time, a small quantity of crushed Connoquenessing sandstone is used for the manufacture of glass in Fayette County. Formerly a much larger production of glass sand in the county came from the Homewood sandstone and sandy lenses in the Carmichaels formation.

The requirements of a sandstone for a good glass sand are largely chemical in nature and have little to do with the physical attributes of the sandstone. SiO_2 is the main constituent of glass sand. However, all natural sand contains impurities, of which Al_2O_3, Fe_2O_3, MgO, CaO, and TiO_2 are the chief ones. These impurities are permissible in varying small quantities. A detailed discussion of the permissible impurities is given by Fettke.[1] A brief summary will be given here:

Al_2O_3 Small amounts of alumina up to 3 or 5 percent are not injurious to glass. For certain types of glass they are actually beneficial.

Fe_2O_3 Iron oxide is the most detrimental impurity of all, because small quantities of it produce color in the glass. The amounts of iron oxide permissible in glass sand vary, depending on the use to which the glass will be put. For plate glass, 0.2 percent is permissible except when the plate glass is used for mirrors, in which case only 0.1 percent is permissible. For window glass and white glass bottles, 0.5 percent of iron oxide does not produce sufficient color to hurt the product. For green and brown glass bottles iron oxide impurities do not make much difference and up to 7 percent of iron is not injurious.

CaO, MgO. CaO is added to most glass sand to produce the common kinds of glass, so that it is not injurious except in the manufacture of special optical glass. MgO in small quantities is not detrimental in the manufacture of glass and the quantity that is commonly found in sandstone is so much less than that brought in with the addition of limestone to the glass mix that it need not be considered here.

TiO_2 In most sandstones the quantity of TiO_2 present is very small and has no effect so far as can be told on the glass.

Besides the chemical character of a sandstone, the grain size is the only character that need be considered. When the sandstone is crushed it commonly breaks into particles of approximately the size of the sand grains in the original sandstone and therefore the size of the original grains is of importance. After crushing, most of the grains should pass through a 30-mesh screen and remain on a 120-mesh screen. The reason for this is based on the processes which are used in making the glass, since particles not passing through the 30-mesh screen would be large and not mix well with the other ingredients of the glass mix, and not melt well when heated, whereas particles passing the 120-mesh are so fine that they would tend to blow away in most glass furnaces.

Silica refractories. Silica refractories are produced at the present time from the Homewood and Connoquenessing sandstones in Fayette County. Both bricks and granular sand are produced. The requirements of a sandstone for use in the manufacture of silica refractories are almost entirely chemical. A detailed discussion of these is given by Moore and Taylor.[2] Briefly:

SiO_2 is the main constituent and must comprise over 96 percent.
Fe_2O_3 must be less than 2 percent of the rock.
Al_2O_3 less than 1.5 percent.
Alkalies less than 0.5 percent each.

However, too pure a sandstone would not be suitable either, since 1.5 percent of the oxide impurities is necessary to make a good bond in the brick when it is heated.

Besides the chemical requirements listed above, it is of advantage to have the grains of the sandstone angular, as they will bond together better than if they are round.

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[1] Fettke, C. R., Glass Manufacture and the Glass Sand Industry of Pennsylvania: Pennsylvania Topo. and Geol. Survey, Report No. XII, pp. 38-54, 1918.

[2] Moore, E. S., and Taylor, T. G. The Silica Refractories of Pennsylvania: Pennsylvania Topo. and Geol. Survey, Bull. M3, pp. 17 and 18, 1924.

Building stone and flagstone. Considerable sandstone is quarried in Fayette County for local building stone and occasionally some is quarried for flagstone. The requirements for building and for flagstone are largely dependent on the chemical constituents in so far as they affect the physical characteristics and the ability of the rock to resist weather. The physical requirements may be summarized as follows. The hardness required of a sandstone depends on the use to which the material is put; for sidewalls of buildings, etc., the hardness is of little importance, but where the stone is to be used for door sills or flagstone, hardness is important, since these stones undergo considerable abrasion. The color of sandstone used for building stone must be pleasing to the user, and therefore it is of the highest importance except where the stone is used in retaining walls and cellars.

The strength of sandstone is nearly always ample for any purpose for which it is used. The structure of the sandstone is chiefly important in its effects on the quarrying and dressing of the blocks for use. In order to produce building blocks, the bedding and joint planes should be at right angles, as then the blocks break out in regular shapes that are suitable for building. Also these fracture planes must be sufficiently far apart to produce blocks of the required sizes. The requirement for flagstone is that it be tough and split in slabs of the desired thickness with at least one smooth face.

Crushed stone. Crushed stone is produced only in very small quantities in Fayette County. The chemical somposition of the sandstone is of no consequence in so far as it affects the physical properties and with a thorough study of these, it need not be considered in regard to the use of crushed stone. The color of the rock is seldom of any importance, since crushed stone is not used for purposes where its color affects the product.

As the sandstone is broken into small angular pieces, the larger structure, such as jointing and bedding, is of little importance. Bedding planes, however, must not be so closely spaced that the broken pieces of the greatest diameter are more than five times the least diameter. For use on roads, the Pennsylvania Highway Department has established a set of physical tests which show the hardness and strength of the rock. The Highway Department has cooperated with this Survey by making physical tests of the Fayette County sandstones. These tests are given at the end of the chapter and aid in determining the usefulness of the various sandstones. The specifications of the Highway Department require a percentage of wear less than 5 and a toughness of more than 6 in their scale, if the crushed stone is to be used for highway surfacing, whether the bond is cement or some bituminous preparation.

Natural stone base. Many of the sandstones in Fayette County are used in constructing the base of many roads throughout the county. The requirements of sandstone for this purpose are largely physical and the chemical composition is of importance only in so far as it affects the physical characteristics of the rock. The color of the material is of no importance. The structure is of little importance, except that the bedding plans must be far enough apart so that pieces do not have their longest diameter more than five times the least diameter.

Hardness and strength are based upon the scale set up by the Highway Department, and explained under crushed stone. However, for some of the secondary roads, the requirements are less strength, and a percentage of wear of 7 or 8 is allowed as well as a toughness of only 3 or 4.

Miscellaneous uses. Molding sand has been produced from the Carmichaels formation and some of the terrace deposits along the Youghiogheny River, as well as from the Connoquenessing sandstone. For details of the requirement of sand to be suitable for use as molding sand, the reader is referred to Molding Sands of Pennsylvania, by R. W. Stone.* Summarized, the chief requirements of molding sand are physical and depend on the grain size and the clay content of the sand. The American Foundrymen's Association has developed tests which show the bonding strength and the permeability of the sands.

Sand for blasting is produced from the Connoquenessing sandstone in Fayette County. The chief requirements for sand-blast material are physical. It must be composed chiefly of hard angular grains.

Stratigraphic and Areal Distribution

Sandstones are distributed throughout the columnar section of Fayette County. Most of these sandstones, because of their shaly impurities, are not suitable for general use, and even the best of them are suitable for high-grade material only in particular localities. The Devonian sandstones are not quarried, largely because their outcrops are not readily available, but partly because sandstones of better grade are always available in the localities where the Devonian crops out. Sandstones in the Pocono and in the Mauch Chunk groups are inferior to the Pottsville sandstones which immediately overlie them and for that reason are seldom used. The Homewood sandstone at the top of the Pottsville is the purest and best sandstone in Fayette County and it is suitable for uses which require a high degree of chemical purity as well as for the less strict requirements of crushed stone and natural stone base. The Connoquenessing sandstone, lying below the Homewood in the Pottsville, is second only to the Homewood in quality.

Sandstones above the Pottsville beds commonly are shaly and contain considerable iron, but in places the shale content is sufficiently low for them to be used for natural stone road base and for building and flagstones.

Most of the sandstone quarries are in the western part of the county. The best material crops out, however, in the central and eastern parts, where the sandstone is commonly procured from ledges and boulders, so that few quarries have been opened there.

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* Stone, R. W., Molding Sands of Pennsylvania: Pennsylvania Topo. and Geol. Survey, Bull. M 11, pp. 12-27, 1928.

Detailed Description of Strata and Quarries

DEVONIAN SANDSTONES

The Devonian sandstones have not been quarried in Fayette County, but a few of them are sufficiently hard and strong to be used as natural stone base or as crushed stone for highway purposes. However, the outcrops are so restricted and commonly so inaccessible that it is doubtful if much use will ever be made of these sandstones.

POCONO SANDSTONE

The Pocono sandstone lies above the Devonian strata, from which it is separated by an angular unconformity, and below the Loyalhanna siliceous limestone. In western Pennsylvania the Pocono strata are commonly divided into three members, the Burgoon sandstone, Cuyahoga shales and the Berea sandstone. It is not definitely known whether these three formations are present in Fayette County, or whether the whole Pocono is Burgoon with the two lower members missing. If these three members are present, the Cuyahoga shales have become extremely sandy and in part are replaced by sandstone. In this report the whole is treated as one sandstone and called Burgoon.

The Pocono sandstone is commonly gray. Hard and coarse-grained conglomeratic lenses are common in the upper and lower parts, but are not more than a few feet thick. The pebbles, which are about the size of peas, are white quartz. The formation ranges from 250 to 350 feet in thickness and is generally about 300 feet. Of this thickness, more than 200 feet is commonly made up of hard sandstone and conglomerate, and 50 to 100 feet is sandy shale and shale. The hard sandstone commonly lies near the top and base of the formation and the shales with interbedded sandstone occupy the middle.

A quarry (221) has been opened on the Burgoon sandstone half a mile north of Summit on Chestnut Ridge; about 20 feet of gray sandstone is exposed. No other quarries were found on the Burgoon, but in many places this sandstone has been quarried from boulder fields and ledges on steep hillsides.

The Pocono sandstone is used in Fayette County for natural stone base in some highway construction, but only to a limited extent because of the better-grade sandstone outcropping nearly everywhere near the Pocono. The physical analysis at the end of the chapter shows a stone that is not suitable for highway surfacing, but only weathered material was sampled. It is quite probable the fresh Pocono would pass the requirements.

MAUCH CHUNK SANDSTONES

Lenses of micaceous sandstone occur interbedded with the Mauch Chunk shales. Thin sandstones are known in the shales below the Greenbrier limestone, but most of the Mauch Chunk sandy beds occur above the limestone.

Mauch Chunk sandstones are buff to brown, commonly thin-bedded and cross-bedded, and contain considerable mica along the bedding planes. They occur as lenses in the red and green shales. Commonly the sandstone lenses are less than 10 feet thick, but a few are 30 and 40 feet thick.

The Mauch Chunk sandstones have been used to a very small extent for natural stone road base, but they have never been quarried in the county, and only rock taken from road cuts and boulder fields has been used. Because of their close stratigraphic proximity to the overlying Homewood and Connoquenessing sandstones, it is doubtful if the Mauch Chunk sandstones will ever be quarried extensively.

CONNOQUENESSING SANDSTONE

Connoquenessing sandstone occupies the lower half of the Pottsville series in Fayette County. It lies below the Mercer group and above the red Mauch Chunk shales and sandstones, from which it is separated by an unconformity. It is separated locally into an upper and lower sandstone by the Quakertown coal and carbonaceous shale.

The Connoquenessing sandstone is a gray, slightly micaceous, hard, medium- to heavy-bedded sandstone. Cross-bedding is not abundant. In places considerable thicknesses of the sandstone are replaced by sandy shales. The upper and lower members are about equal in thickness, averaging 50 feet apiece and separated by 5 feet of Quakertown coal and shale. Commonly the sandstone is not very pure, as it contains shaly streaks and some mica, feldspar, and iron minerals, but in a few outcrops it is a pure silica sandstone, as along Dunbar Creek.

Quarries have been opened on the Connoquenessing in Dunbar and Connellsville townships, along the west flank of Chestnut Ridge. One of these is of commercial importance, the other is now inactive but of fair size. The Dunbar Corporation operates a mine which has been developed from a quarry (234). Three parallel entries about 40 feet high and 50 feet wide have been driven in the hill from the face of the quarry. These entries are connected by cross cuts of similar size, the roof being supported by pillars 30 by 30 feet. One entry is 1,500 feet long. The operations are entirely by electricity and 20 to 40 men are employed. The property has been operating at capacity for the last few years. The floor of the quarry is the top of the Quakertown carbonaceous shale which at this point is extremely variable and in places cuts upward into the sandstone for 10 or 15 feet, making an irregular floor.

The Connoquenessing sandstone is suitable for use as natural stone road base and has been produced for this use from many boulder fields in the eastern part of the county and from the quarry on the Springfield Pike (72). Where the sandstone is very pure along Dunbar Creek and north to the Youghiogheny River on the west flank of Chestnut Ridge, it is produced from one quarry and mine (234) and has in the past been produced from two others (233 and 237) for use as glass sand, refractory sand, molding and sand-blast sands. After crushing the sandstone must be washed in order to obtain the purity necessary for the first two of these uses. The impurities consist of carbonaceous matter, mica and granular iron (probably magnetite), all of which are easily washed out. The glass sand is used largely in the manufacture of wire glass. It is not sufficiently pure for the manufacture of high-grade glass, such as plate and mirror glass. The refractory sand is sold for furnace linings as sand and is not made into bricks.

HOMEWOOD SANDSTONE

The Homewood sandstone lies above the Mercer group, in the upper part of which it transgresses in some places, and below the Brookville coal of the Allegheny group, from which it is separated by a few feet of clay. This sandstone may be divided into two parts, the upper of which is a medium- to heavy-bedded, white to gray, medium-grained sandstone, and the lower is white to gray, coarse-grained, very massive sandstone. Few impurities are found in the lower bed, except in a few places where recementation has taken place along the joint planes with the addition of iron. The structure of the massive part is very coarse, consisting of two systems of joints at right angles to each other and to the bedding which makes the stone very suitable for quarrying building blocks. The massive sandstone forms cliffs along the flanks of Chestnut Ridge and Laurel Hill.

Quarries. The most important sandstone quarries in Fayette County are in the Homewood. Several of them have been developed into large quarries or mines and will be discussed individually.

The General Refractories Company quarry (45) is on the south bank of the Youghiogheny River at Childs Station, Perry Township. The quarry was formerly owned by the Stewart Fire Brick Co., who made silica brick from the Homewood sandstone. The sandstone was quarried along its outcrop for several hundred feet and recently, when the overburden became too great, the quarry was converted into a mine. From 10 to 15 feet of sandstone is taken out in entries about 20 feet wide. Pillars 20 by 20 feet are commonly left between the entries and crosscuts.

The Harbison-Walker Refractories Company quarry (48) is on the north bank of the Youghiogheny River opposite the General Refractories Company quarry. The quarry operates in the Homewood sandstone, exposing a face 30 feet high and 100 to 200 feet long. The sandstone from this quarry is crushed and shipped to Pittsburgh, where it is made into brick by the company.

The Harbison-Walker Refractories Company owns another quarry (49) a few hundred yards southeast of 48, but it is inactive at present.

The Bigam & Eicher quarry (78) is a short distance south of the Springfield Pike on top of Chestnut Ridge. A 30-foot cliff of massive Homewood sandstone is being quarried to produce building blocks.

The Dunbar Corporation quarry (231) is 1½ miles east of Dunbar on the south side of Dunbar Creek; 50 feet of sandstone has been quarried over an area of several acres. The massive Homewood sandstone here extends downward to the upper Mercer coal, cutting out the Tionesta coal and shales. The quarry is not operated at present, as the Dunbar Corporation is obtaining all the stone they need from the mine in the Connoquenessing sandstone below this quarry floor. When the Connoquenessing mine is extended far underground the Homewood quarry will be operated again.

Sloan's quarry (235) is on the north side of Dunbar Creek, 1½ miles east of Dunbar. The quarry face is 40 to 50 feet high and extends for a mile or more along the outcrop of the Homewood sandstone which emerges from the creek opposite the Dunbar Corporation plant and rises eastward up the ridge between Dunbar Creek and Youghiogheny River. The sandstone produced from this quarry was all used for glass sand and is said to have made a very fine product.

The Williams Brothers quarry (236) is near the crest on the north side of the ridge between the Youghiogheny River and Dunbar Creek. From this quarry, the outcrop of the Homewood forms a cliff extending downward and westward to the Youghiogheny River at the Connellsville Water Company plant. The quarry itself has a face 60 feet high and about 200 feet long, exposing a very pure white, massive sandstone. The Homewood outcrop westward from the quarry has been opened at places and incomplete tests show rock of the same quality as in the quarry itself. This sandstone was quarried many years ago for glass sand, but difficulty in transporting the sand to the market stopped the operation.

The Mason Ryan quarry (266) is ¼ mile south of Springhill, Springhill Township. Thirty feet of massive sandstone overlain by 20 feet of thin, medium-bedded sandstone, are exposed in the quarry. The product of this quarry was crushed for highway use. The quarry has been abandoned for several years.

The Mrs. J. P. McMullen quarry (323) is north of the National Pike, 1 mile east of Pike School on Woodcock Hill. The quarry exposes only 15 to 20 feet of the Homewood sandstone, but the areal extent of the quarry is large and considerable stone has been taken out. It is said the stone was used extensively in building the National Pike. The quarry has been abandoned for many years.

Analyses. Several physical analyses of the Homewood sandstone show it to be suitable for most construction work, in many places, but unfortunately no chemical analyses are available.

Uses. The Homewood sandstone is suitable for several purposes, among which are natural stone base, crushed stone for highway surfacing, building stone, refractory brick, and glass sand. The physical analyses at the end of the chapter show that the Homewood sandstone is suitable for natural stone base even in weathered outcrops, and fresh material is suitable for all types of highway work. The massive part of the Homewood bed where it has been warped on the major anticlines has been fractured by two major joint systems, one of which is parallel to the strike of the anticlinal ridges and the other at right angles, both being at right angles to the bedding of the sandstone. This jointing facilitates quarrying and the stone easily splits into rectangular building blocks. The exceptional purity of the Homewood sandstone makes it suitable for use in making refractory brick.

Although no chemical analyses are available for this report, quarry owners were kind enough to show to the geologists investigating the property such analyses as they had had made. These analyses showed a very high-grade sandstone and the small amount of impurities in this stone could readily be removed by crushing and washing.

KITTANNING SANDSTONE

The Kittanning sandstone of the Allegheny group lies below the Lower Kittanning coal and above the Vanport limestone where the latter is present. It is a brownish, medium- to thick-bedded sandstone, in places cross-bedded. The best exposures of this sandstone are along the Ohiopyle road, from Ohiopyle north to Normalville, and along the west flank of Chestnut Ridge. The sandstone commonly is 15 to 20 feet thick, but it is not persistent throughout Fayette County.

Although there are no quarries on the Kittanning sandstone, several physical analyses were made of this material during the construction of the highway from Connellsville to Ohiopyle to see if it could be used. The physical analyses show that the Kittanning sandstone is suitable for highway purposes and during the construction of the highway from Connellsville to Ohiopyle it was used for natural stone base and also in culvert copings along this highway.

WESTERNPORT SANDSTONE

The Westernport sandstone of the Allegheny group may be divided into two parts by the Middle Kittanning coal and the Johnstown limestone, but in many places the upper and lower parts coalesce to form one thick sandstone. The Westernport sandstone commonly is medium-grained, and micaceous, but at a few places in Fayette County it becomes coarse-grained and even conglomeratic, massive, hard, gray, and forms cliffs.

The Dave Firestone quarry (69), 2 miles northeast of Breakneck, Bullskin Township, opens 15 to 25 feet of Westernport sandstone. During the progress of the field work on this report, stone was being produced from this quarry for natural stone base to be used in the construction of nearby secondary State roads.

The Westernport sandstone has been used extensively for natural stone base for secondary State highways in several parts of the county. Where the sandstone is thick and massive, as at Whites Bridge, and along the National Pike on the west flank of Chestnut Ridge, the sandstone is eminently suitable for this purpose. See Figure 19.

FREEPORT SANDSTONE

The Freeport sandstone lies above the Upper Kittanning coal and below the Lower Freeport coal, from which it is separated by the Lower Freeport fire clay and limestone. Commonly it is a thin- to medium-bedded, fine-grained, shaly sandstone with much mica on the bedding planes. In thickness it ranges from 10 to 25 feet and is best exposed in the Indian Creek valley.

The Freeport sandstone is shown by the physical analyses to be suitable for natural stone base, but has not been used for such so far, to the author's knowledge. The boulder field on the Hay farm, where the sample was taken for analysis, produced stone which was used for culvert copings along the Normalville-Ohiopyle road.

MAHONING SANDSTONE

The Mahoning sandstone, at the base of the Conemaugh group, is commonly divided into two parts by a shale interval which may contain fire clay, limestone, red shale and up to three beds of coal.

The Lower Mahoning sandstone in many places lies directly on the Upper Freeport coal, but in other places is separated from this coal by the Uffington shale and Upper Freeport rider coal. The Upper Mahoning sandstone lies below the Brush Creek coal, from which it is separated by a few feet of shale.

The Mahoning sandstone is commonly a brownish, medium-grained, cross-bedded sandstone, but in many places becomes a coarse-grained, hard, massive- or heavy-bedded sandstone which may contain conglomeratic lenses. The total thickness of the Mahoning sandstones and interbedded material is fairly constant throughout the county, averages about 100 to 120 feet; the lower sandstone ranges from 10 to 50 feet in thickness and averages in the vicinity about 30 feet, whereas the upper sandstone is 20 to 40 feet and also averages about 30 feet.

The Mahoning sandstone has been opened in few quarries because of its proximity to the overlying Conemaugh sandstones of greater thickness and better quality, and to the Homewood sandstone of similar thickness, but much better quality. Three active quarries are known in Fayette County, one of which is in Lower Tyrone Township, the other two in Wharton Township. See Figure 22.

Several physical analyses of the Mahoning sandstone are available because of recent activity at the quarries where stone is being produced for use as natural stone road base for secondary State highways.

The Lower Mahoning sandstone is used fairly extensively for natural stone road base in the eastern part of Fayette County. In the central part of Ohiopyle Valley it has largely been gathered from boulder fields, but in the southern part two quarries made most of the stone needed.

BUFFALO SANDSTONE

The Buffalo sandstone of the Conemaugh group lies above the Brush Creek coal and limestone, and below the Cambridge limestone, and is associated with the Meyersdale red shale. Commonly this sandstone is thin-bedded, shaly, weak sandstone or sandy shale, but in the southern part of the Ohiopyle Valley it becomes thick, massive, brown, coarse-grained, in places conglomeratic, and forms flats and occasional cliffs on the hillsides.

The Buffalo sandstone, although not quarried, has been produced extensively from boulder fields in the vicinity of Gibbon Glade and was used as natural stone base in the construction of secondary highways in this part of Fayette County. The analysis given shows that the Buffalo sandstone where it crops out is suitable for natural stone base, but not for other highway construction purposes. However, this sample is only outcrop stone; the fresh material probably would be stronger and suitable for all highway purposes.

SALTSBURG SANDSTONE

The Saltsburg sandstone of the Conemaugh group lies above the Bakertown coal and below the Ewing limestone and Pittsburgh red beds. Throughout Fayette County it varies from massive, thick-bedded, brown and gray, coarse-grained to weak, thin-bedded shaly sandstone and sandy shale. In thickness the sandstone averages 80 feet, but is usually split in several parts by sandy clay-shale and sandy shale which form as much as 50 percent of the bed.

The Saltsburg sandstone has been opened in several quarries west of Chestnut Ridge, few of which are active at present. Although the physical analyses of the Saltsburg sandstone given at the end of the chapter show that it is not suitable for any highway construction, the sandstone is quarried and used in building the base of secondary State highways and county and township roads.

MORGANTOWN SANDSTONE

The Morgantown sandstone lies above the Barton coal and limestone and below the Lonaconing coal and clay and Clarksburg limestone. It is like the Saltsburg sandstone in its variability. In some places it is a medium-bedded, brown, micaceous shaly sandstone; in others a massive, gray or brown, medium-grained, hard sandstone. The thickness ranges from 50 to 80 feet and commonly includes interbedded sandy shales and shaly sandstones.

Morgantown sandstone quarries are fairly numerous along the west flank of Chestnut Ridge and along the Fayette anticline. This sandstone is not quarried extensively at present in Fayette County, but in the past has been produced for use on county and township roads and for local building stone. See Figure 23.

CONNELLSVILLE SANDSTONE

The Connellsville sandstone near the top of the Conemaugh group lies above the Little Clarksburg coal and below the Lower Pittsburgh limestone and Little Pittsburgh coal. It is more persistent in character than the other major Conemaugh sandstones; commonly it is a gray to buff, medium- to coarse-grained sandstone in massive beds; in places cross-bedding is prevalent. The thickness ranges from 50 to 80 feet, most of which is sandstone, but some interbedded sandy shale commonly is present. See Figure 24.

More quarries have been opened on the Connellsville sandstone than any other sandstone in Fayette County, except the Waynesburg, which lies a considerable distance higher in the section. Although none of the quarries are very large, several have produced considerable amounts of stone. This sandstone is quarried extensively for use as natural stone road base on secondary State highways, as well as county and township roads. In the past, where the structure was suitable, building stone has also been produced from many of these quarries.

PITTSBURGH SANDSTONE

Stratigraphic position. The Pittsburgh sandstone is at the base of the Monongahela group. It lies above the Pittsburgh coal, from which it is commonly separated by several feet of carbonaceous shale, and below the Redstone limestone. The Pittsburgh sandstone is commonly a thin- to medium-bedded, fine-grained shaly sandstone, but in some parts of the county becomes coarse-grained, heavy- to massive-bedded, with small amounts of mica and occasional conglomeratic lenses. In thickness it is very irregular, commonly occurring as two beds separated by the Pittsburgh rider coal and shale. The upper bed ranges from 0 to 30 feet in thickness, and averages about 15 feet; the lower bed, which ranges from 0 to 35 feet, averages 20 feet in thickness in a few places. Where the sandstone is coarse and massive, the upper and lower beds coalesce and the whole becomes quite thick.

Two quarries have been opened on the Pittsburgh sandstone in Franklin Township, near Elm Grove. An analysis was made of the sandstone from the Cyrus Clark quarry (200), which was being operated at the time of the report. At the places where the Pittsburgh sandstone is coarse-grained and hard, it is suitable for highway construction and has been quarried for use as natural stone road base and rough building stone.

SEWICKLEY SANDSTONE

The Sewickley sandstone in the Monongahela group lies between the Upper and Lower Sewickley coals. Commonly it is a brown, medium-bedded to heavy-bedded, coarse sandstone showing considerable cross-bedding. Occasionally the sandstone is thin-bedded and shaly. The thickness ranges from 10 to 30 feet and averages 20.

Several quarries have been opened on the Sewickley sandstone west of Chestnut Ridge and mostly in the northern part of the county. Although none of the quarries are large, a few have produced fair quantities of stone. Although the Sewickley sandstone is not quarried to any great extent at the present time, quarrying has been active in the past and two physical analyses have been made. At present the Sewickley sandstone is quarried for use as natural stone road base only, but in the past most production was for building stone. This stone was used in building coke ovens between Star Junction and Perryopolis.

UNIONTOWN SANDSTONE

The Uniontown sandstone lies above the Uniontown coal and below the Lower Waynesburg limestone. Commonly it is shaly, thin- to medium-bedded, fine-grained, brown material, but in some parts of the county it becomes more massive, fairly hard, coarse-grained, thick-bedded sandstone showing moderate amounts of cross-bedding in a few places. The bedding planes are usually covered with mica flakes. The thickness ranges from 0 to 20 feet, and averages about 10 feet.

Samples were collected from some of the Uniontown quarries which were producing stone for use as highway base material at the time the writer visited these localities. The Uniontown sandstone, as shown by the analyses given, is suitable for natural stone base only, and it has been used for this purpose on some of the secondary highways in the western part of the county.

GILBOY SANDSTONE

The Gilboy sandstone of the Monongahela group rests on the Little Waynesburg coal and is separated from the Waynesburg coal above by clay and shale; in the western part of the county where the Waynesburg coal in places is lacking the Gilboy sandstone coalesces with the Waynesburg sandstone.

The Gilboy sandstone is medium- to coarse-grained, medium- to heavy-bedded, gray to brown, with little interbedded shale. In thickness it ranges from 0 to 30 feet, averaging about 15 feet.

In the northern part of Fayette County, west of Chestnut Ridge, many quarries have been opened and the Gilboy sandstone is quarried at present for use as natural stone road base for secondary highway construction and county and township roads. The analysis at the end of the chapter shows that the stone is not suitable for use on primary highways. A small quantity of this sandstone has been quarried for rough building purposes.

WAYNESBURG SANDSTONE

The Waynesburg sandstone is at or near the base of the Washington group. It lies below the Mount Morris limestone and above the Waynesburg coal, from which it is separated by the Cassville shale and Elm Grove limestone wherever they are present. The character of the Waynesburg sandstone varies greatly from place to place. Commonly it is a medium to coarse, brown, heavy-bedded sandstone containing a small amount of mica, feldspar and iron, whereas in other places a considerable part of the sandstone has been replaced with sandy shale. The shaft sections along the Lambert syncline show the Waynesburg sandstone broken into several parts by thin limestones and shales.

The Waynesburg sandstone has been opened by more quarries than any other sandstone in Fayette County. Many of these quarries are small and have only been opened to procure stone for local roads; none of them are very large. The Waynesburg sandstone is used chiefly at present for natural stone base for highways and county and township roads. In the past it has been quarried extensively for building stone and many of the larger buildings in the county are built of blocks from the more massive parts of this sandstone. See Figure 33.

MANNINGTON SANDSTONE

The Mannington sandstone is in the lower part of the Washington group. It lies above the Calvin Run and Woodglen limestones and below the Little Washington coal. Commonly it is divided into two parts which are separated by the Waynesburg B coal when it is present. The Mannington sandstone is a medium- to coarse-grained, brown, medium-bedded material quite similar to the Waynesburg in appearance. The upper part of the sandstone ranges from 5 to 20 feet in thickness and averages 10 or 15 feet. The lower part ranges from 0 to 6 feet in thickness and averages 4 feet. In several places the Waynesburg B coal is lacking and the upper and lower parts of this sandstone coalesce.

A few quarries have been opened on the upper part of the Mannington sandstone. They are all in the northern half of the county west of Chestnut Ridge. This sandstone has been quarried for natural stone road base for use on near-by country roads.

WASHINGTON SANDSTONE

The Washington sandstone of the Washington group lies above the Little Washington coal and Bristol limestone and below the Washington coal. Commonly it is a thin-bedded, brownish, micaceous sandstone, ranging from 0 to 35 feet thick, averaging 10 feet in the Klondike district and 20 feet in the Uniontown-Connellsville district. Two quarries have been opened on this sandstone, only one of which is active. It is near New Salem along the Lambert synclinal axis. A sample was collected from the one active quarry on the Washington sandstone to test its suitability for highway construction.

DAVISTOWN SANDSTONE

The Davistown sandstone lies above the Middle Washington limestone and below the Jollytown coal. It is a persistent, medium- to heavy-bedded, brown to gray, coarse-grained sandstone which contains a little mica on the bedding planes. Cross-bedding is not conspicuous. The thickness ranges from 10 to 30 feet and averages about 20 feet.

Four quarries have been opened on this sandstone south of Brownsville along the National Pike. Three of them are active at present. A sample was taken from the larger and most active of these quarries to test the suitability of the stone for highway purposes. The Davistown sandstone is principally used for natural stone road base in the vicinity of the quarries. It is suitable for any type of road base and is probably suitable for many building stone purposes owing to the thickness of the beds and regularity of the jointing in some of the quarries.

BRIER HILL SANDSTONE

The Brier Hill sandstone is directly under the Upper Washington limestone and is separated from the Jollytown coal by several feet of shale. At its type locality at Brier Hill it is a massive, coarse-grained, brown to gray, hard material. The massive character, however, is not persistent throughout its outcrop and southward the sandstone becomes medium-bedded and somewhat micaceous. In thickness it ranges from 10 to 30 feet and averages about 15 feet.

The Brier Hill sandstone has not been quarried in Fayette County and owing to its restricted outcrop in the tops of the higher hills along the deepest part of the Lambert syncline, it is of little economic importance.

DUNLAP SANDSTONE

The Dunlap sandstone lies near the base of the Greene group. It is the highest stratum preserved in Fayette County and lies about 20 feet above the Upper Washington limestone, from which it is separated by shales. It is a thin-bedded, greenish-brown, micaceous sandstone, shaly in parts. It ranges in thickness from 10 to 35 feet and averages about 25 feet. It has a very restricted outcrop, being found in only about seven or eight of the highest hills along the deepest part of the Lambert syncline.

Sandstone quarries in Fayette County

No.	Township	*Status	Strata	Owner
221	North Union	I	Burgoon	
72	Connellsville	I	Connoquenessing	Frank Zacharias
233	Dunbar	I	"	Dunbar Corporation No. 2
234	"	A	"	" " No. 3
237	"	I	"	McFarland Quarry
45	Perry	A	Homewood	General Refractories Co.
48	Lower Tyrone	I	"	Harbison-Walker Ref. Co.
49	" "	I	"	" " " "
78	Springfield	A	"	Bigam & Eicher (Bldg. blocks)
232	Dunbar	I	"	Dunbar Corporation No. 1
235	"	I	"	Sloan's Quarry
236	"	I	"	Williams Brothers
251	Wharton	A	"	Indian Creek Coal & Coke Co.
266	Springhill	I	"	Mason Ryan
305	Stewart	I	"	
306	"	A	"	
323	Henry Clay	I	"	Mrs. J. P. McMullen
69	Bullskin	A	Westernport	Dave Firestone
50	Lower Tyrone	A	Mahoning	J. M. Lucky
263	Wharton	A	"	Chas. Gleason
270	"	A	"	R. P. McClellan
46	Perry	I	Saltsburg	James March
47	"	A	"	Livingston Hoak
146	Franklin	I	"	A. C. Brown
193	Georges	I	"	I. C. Stone
219	North Union	A	"	Yartz Quarry
37	Franklin	P	Morgantown	G. E. Allen
51	Lower Tyrone	I	"	W. B. Horn
53	" "	I	"	Henry Davis
67	Bullskin	I	"	M. W. Jurrick, Jr.
151	Menallen	I	"	Waltersburg Coal & Coke Co.
157	"	I	"	Sam Roderick Heirs
158	"	I	"	Albert Holland
174	German	I	"	R. Core
181	Nicholson	A	"	A. I. West
15	Perry	I	Connellsville	Washington Coal & Coke Co.
35	Franklin	I	"	" " " " "
52	Lower Tyrone	I	"	Mary Oland (Ernest Graff)
54	" "	I	"	Filmer Cotton
55	" "	A	"	Thomas Sproat
56	" "	I	"	Frank Zorn
64	Bullskin	I	"	Frank Bittner
94	Dunbar	I	"	Pittsburgh & Lake Erie Railroad ?
95	Dunbar	I	"	A. S. Snyder
96	"	A	"	Vanderbilt Borough
159	Menallen	A	"	Denney Brothers
160	"	A	"	Earl Fisher
161	South Union	I	"	Roy Beatty

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* A, active; I, inactive; P, prospect pit.

No.	Township	*Status	Strata	Owner
169	German	I	Connellsville	S. & H. Poundstone
170	“	I	“	Allan Newcomer
171	“	I	“	Albert Riffle
172	“	I	“	S. B. Rothamel
173	“	A	“	C. A. Jones
176	Nicholson	A	“	Isaiah Cover
177	“	A	“	J. S. David
178	“	I	“	Earl Diffenbaugh
179	“	I	“	Hague Farm
180	“	I	“	Jeff. Fast
192	Georges	A	“	Emily Thomas
194	Springhill	I	“	E. P. Conn
195	“	I	“	Chas. McClain
200	Franklin	A	Pittsburgh	Cyrus Clark
201	“	I	“	Geo. Bavrcy
8	Perry	I	Sewickley	Washington Coal & Coke Co.
10	“	I	“	“ “ “ “ “
11	“	I	“	“ “ “ “ “
12	“	I	“	“ “ “ “ “
13	“	I	“	“ “ “ “ “
16	“	I	“	“ “ “ “ “
59	Upper Tyrone	I	“	S. Geissler
82	Dunbar	I	“	Anna E. Work
93	“	A	“	O. H. Shallenberger
97	“	I	“	Martin Maligney
98	“	I	“	John H. Thomas
199	Franklin	I	“	Frank Remback
247	Georges	I	“	Irving Coal & Gas Co.
3	Washington	I	Arnoldsburg	Robert Gilbert Farm
14	Perry	I	“	Washington Coal & Coke Co.
197	Franklin	I	“	Frank Remback
4	Perry	A	Uniontown	Andy Bordash
20	Jefferson	I	“	Grace Wood
25	“	I	“	W. B. Donnells
26	“	I	“	J. S. Wells
114	Luzerne	A	“	R. N. Miller
125	“	I	“	J. V. Thompson
27	Jefferson	I	Gilboy	C. H. Nutt
43	Redstone	I	“	W. S. McCay
111	Luzerne	I	“	P. E. Vernon
113	“	I	“	James Buck
121	“	I	“	J. & M. West
122	“	I	“	“ “ “ “
128	“	A	“	D. C. Lightly
215	North Union	I	“	Mrs. A. A. Ross
216	“ “	I	“	Mrs. Eliza Zelinko
226	Dunbar	I	“	H. C. Frick Coal & Coke Co.
227	“	I	“	“ “ “ “ “ “ “

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* A, active; I, inactive; P, prospect pit.

Sandstone quarries

No.	Township	*Status	Strata	Owner
9	Perry	I	Waynesburg	Mary A. Strickler
23	Jefferson	A	"	Snowden Farm
24	"	A	"	O. R. Elliot Heirs
28	"	A	"	Israel Vorhis
32	"	I	"	Maria Krell
38	Redstone	I	"	Jane Vankirk Estate
40	"	I	"	Elizabeth Sharpneck
41	"	I	"	" "
85	Dunbar	I	"	Frank Czerwik
115	Luzerne	I	"	Geo. Moore
116	"	A	"	John Horner
117	"	I	"	Geo. Denney
118	"	I	"	" "
119	"	I	"	Hamilton Newcomer
120	"	I	"	Isabelle Coal & Coke Co.
123	"	A	"	Joseph Acklin
124	"	I	"	I. N. Crafts
126	"	I	"	Isabelle Coal & Coke Co.
129	Redstone	I	"	Thompson & Seamans
133	"	I	"	J. B. Van Kirke
143	"	I	"	W. J. Rainey Coal & Coke Co.
164	South Union	A	"	F. M. Helen
165	German	I	"	H. C. Frick Coal & Coke Co.
168	"	I	"	" " " " " " "
175	"	I	"	Jesse Hoover
209	North Union	I	"	Frank Gastkill
224	Dunbar	I	"	H. C. Frick Coal & Coke Co.
225	"	I	"	" " " " " " "
30	Jefferson	I	Lower Mannington	Geo. Rodenback
130	Redstone	I	Upper Mannington	John Phillips
144	"	I	" "	Connellsville Coal & Coke Co.
222	Dunbar	I	" "	H. C. Frick Coal & Coke Co.
167	German	A	Washington	Sam Moore
223	Dunbar	I	"	Mrs. Eva Meyers
131	Redstone	A	Davistown	Helen Bowman Heirs
132	"	A	"	W. G. Higginbottom
136	"	A	"	Elisa Roberts
138	"	I	"	A. W. Roberts
141	Redstone	A	Dunlap	Benj. Phillips

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* A, active; I, inactive; P, prospect pit.

Physical analyses of Fayette County sandstones

[Analyst, Pennsylvania Department of Highways Testing Laboratory]

Sample No.	Sp. gr.	Weight lbs./cu. ft.	Absorption	Wear		Toughness	Remarks
				Percent	Fr. coef.		
Pocono							
F-122	2.49	155.4	3.88	5.3	7.6	8	B
Mauch Chunk							
F-138	2.66	162.0	0.46	3.3	12.1	14	A
Connoquenessing							
F-136	2.51	156.6	3.43	4.8	8.3	5	B
Homewood							
F-7	2.50	156.0	3.29	6.0	6.7	5	B
F-123	2.52	157.2	3.30	6.2	6.5	6	B
F-130	2.47	154.1	1.63	4.9	8.2	8	A
F-141	2.51	156.0	2.34	3.0	13.3	9	A
F-148	2.43	151.6	1.05	5.0	8.0	—	—
F-152	2.59	161.6	0.42	2.1	19.0	13	A
Kittanning							
F-125	2.61	162.8	3.66	4.0	10.0	10	A
F-129	2.53	157.9	2.89	3.4	11.8	8	A
F-137	2.47	145.1	2.29	3.3	12.1	8	A
Freeport							
F-121	2.56	161.0	2.90	7.6	5.3	8	B
Mahoning							
F-126	2.45	152.9	4.43	8.9	4.5	3	N
F-124	2.51	156.6	4.07	6.2	6.5	6	B
F-128	2.45	152.9	5.12	10.0	4.0	6	B
F-1	2.55	159.1	2.34	2.9	3.8	9	A
F-1a	2.66	166.0	2.57	4.0	10.0	9	A
F-3	2.49	155.4	2.58	3.7	10.8	6	A
F-127	2.58	161.0	2.82	7.4	5.4	11	B
F-48	2.51	156.6	2.51	4.1	9.8	5	B
Buffalo							
F-2	2.45	152.9	3.74	7.8	5.1	7	B
Saltsburg							
F-49	2.47	154.1	3.54	6.3	6.4	4	N
F-74	2.55	159.1	4.18	4.1	9.8	4	N
Morgantown							
F-58	2.54	158.5	3.30	6.0	6.7	4	N
F-16	2.45	152.9	6.73	11.6	3.4	3	N
F-75	2.55	159.1	5.03	6.8	5.9	3	N
F-64	2.53	157.9	4.89	5.5	7.3	7	B
Connellsville							
F-55	2.50	156.0	5.09	6.4	6.3	3	N
F-57	2.59	161.6	4.04	4.6	8.7	6	A
F-73	2.43	151.6	5.99	12.2	3.3	1	N
F-9	2.47	154.1	4.53	5.0	8.0	6	A
Pittsburgh							
F-17	2.48	154.7	4.42	5.1	7.8	8	A
Sewickley							
F-69	2.51	156.6	3.98	4.8	8.3	5	B
F-47	2.51	156.6	5.21	4.1	9.8	5	B
Uniontown							
F-41	2.48	154.7	4.02	5.3	7.6	5	B
F-34	2.48	154.7	4.82	5.8	6.9	6	B
Gilboy							
F-35	2.49	155.4	4.9	7.1	5.6	4	N
Waynesburg							
F-44	2.40	149.7	5.01	11.6	3.4	3	N
F-33	2.50	156.0	4.19	7.8	5.1	4	N
F-14	2.43	151.0	6.54	11.4	3.5	5	B
F-39	2.47	154.1	4.68	7.7	5.2	5	B
F-144	2.62	163.5	1.64	5.2	7.7	7	A
Washington							
F-37	2.48	154.8	5.79	11.0	3.6	5	B
Davistown							
F-72	2.52	157.2	4.50	5.9	6.8	6	B

A—Acceptable for all highway construction.
B—Acceptable only for native stone base construction.
N—Not acceptable for any highway construction.

Localities from which samples were collected

F-122. Pocono sandstone. Boulder field on Daniels farm (221), Stewart Township, ¼ mile east of Rock Spring School; gray sandstone boulder sampled.

F-138. Mauch Chunk sandstone. Road cut on W. D. McGinnis farm, 2½ miles east of Connellsville, on the Springfield Pike, Connellsville Township; 10 feet of hard, micaceous, buff sandstone exposed.

F-136. Connoquessing sandstone. Frank Zacharias quarry (72), 2 miles east of Connellsville-Springfield Pike, Connellsville Township; 40 feet of medium-bedded, gray sandstone exposed.

F-7. Homewood sandstone. Mason Ryan quarry (266), ¼ mile south of Springhill, Springhill Township; 20 feet of massive sandstone sampled.

F-123. Homewood sandstone. Cliff on Woodmancy farm, ½ mile east of Kaufmann, Stewart Township; 15 feet of massive, gray pebbly sandstone exposed.

F-130. Homewood sandstone. Kendall quarry (306), ¼ mile south of Ohiopyle; 25 to 30 feet of massive, pebbly sandstone exposed.

F-141. Homewood sandstone. McMullen quarry (323), north of National Pike, 1 mile east of Pike School on Woodcock Hill, Henry Clay Township; 30 feet of massive, gray sandstone exposed.

F-148. Homewood sandstone. James Harper land, ¾ mile east of Dunbar, Dunbar Township. The location of this sample is not clearly known, but was probably the lowest part of the old Sloan quarry (235).

F-152. Homewood sandstone. Boulder on the Holt Estate north of the National Pike at Pike School, Henry Clay Township.

F-125. Kittanning sandstone. Stull heirs farm, 4 miles south of Mill Run, Stewart Township; 15 feet buff, micaceous sandstone exposed.

F-129. Kittanning sandstone. Johnson farm, 2 miles southeast of Mill Run, Springfield Township; several ledges of medium- to heavy-bedded, micaceous sandstone exposed.

F-137. Kittanning sandstone. W. M. Bassinger farm, ¼ mile east of Rassler Run, Springfield Township; road cut exposes 15 feet of hard, gray sandstone.

F-121. Freeport sandstone. Boulder field on Hay farm, ½ mile north of Three Maples School, Stewart Township.

F-126. Mahoning (lower) sandstone. Ohler farm, 2¾ miles south of Mill Run, Stewart Township.

F-124. Mahoning (lower) sandstone. Boulder field on Scarlet farm, ¼ mile south of Three Maples School, Stewart Township.

F-128. Mahoning (lower) sandstone. Boulder field on Rommel Various farm, 2 miles south of Mill Run, Springfield Township.

F-1. Mahoning (lower) sandstone. R. P. McClellan quarry (270), 1 mile west of Gibbon Glade, Wharton Township; 20 feet of hard, massive, gray sandstone sampled.

F-3. Mahoning (lower) sandstone. Boulder field, 2 miles south of Ohiopyle, on Route 448, near Oak Grove School, Stewart Township.

F-127. Mahoning (upper) sandstone. Boulder field on Schraver farm, 2¼ miles south of Mill Run, Springfield Township.

F-48. Mahoning (upper) sandstone. J. M. Luckey quarry (50), ¼ mile west-southwest of Stickel, Lower Tyrone Township; 15 feet of sandstone sampled.

F-2. Buffalo sandstone. Boulder field on Harry Knox Farm, ½ mile south of Gibbon Glade at Canaan School. Wharton Township.

F-49. Saltsburg sandstone. Livingstone & Hoak quarry (47), 1 mile north of Layton, Perry Township; 15 feet light gray sandstone sampled.

Localities from which samples were collected

F–74. Saltsburg sandstone. I. C. Stone quarry (193), northwest of Haydentown, Georges Township; 40 feet massive, gray sandstone sampled.

F–58. Morgantown sandstone. Wm. B. Horn quarry (51) 1¼ miles south of Tyrone, Lower Tyrone Township; 15 feet of massive, coarse-grained sandstone sampled.

F–16. Morgantown sandstone. Walterburg Coal & Coke Co. quarry (151), 1 mile west of Waltersburg, Menallen Township; 35 feet of massive, gray sandstone sampled.

F–75. Morgantown sandstone. A. I. West quarry (181), 2½ miles southwest of Smithfield, Nicholson Township; 25 feet of massive, brown sandstone sampled.

F–64. Morgantown sandstone. M. W. Junick, Jr., quarry (67), ½ mile south of Hammondsville, Bullskin Township; 13 feet of medium-bedded, micaceous sandstone sampled.

F–55. Connellsville sandstone. Vanderbilt Boro quarry (96), ⅓ mile west of Vanderbilt, Dunbar Township; 12 feet of heavy, gray sandstone sampled.

F–57. Connellsville sandstone. Thomas Sprout quarry (55), 2 miles north of Dawson, Lower Tyrone Township; 20 feet of sandstone exposed.

F–73. Connellsville sandstone. Denny Brothers quarry (159), 1 mile north of Balsinger, Menallen Township; 18 feet of medium-bedded, gray sandstone sampled.

F–9. Connellsville sandstone. J. S. David quarry (177), ½ mile north of Woodside, Nicholson Township; 25 feet of heavy-bedded, gray sandstone sampled.

F–17. Pittsburgh sandstone. Cyrus Clarke quarry (200), Elm Grove, Franklin Township; 25 feet of hard, gray sandstone sampled.

F–69. Sewickley sandstone. Martin Maligney quarry (97), 1 mile south of Vanderbilt, Dunbar Township; 15 feet of medium-bedded, gray-brown sandstone sampled.

F–47. Sewickley sandstone. Washington Coal & Coke Company quarry (13), at Star Junction, Perry Township; 15 feet of fine-grained, micaceous, thick-bedded sandstone sampled.

F–41. Uniontown sandstone. Andy Bordash quarry (4), 2 miles west of Perryopolis, Perry Township; 12 feet of hard, gray sandstone under 8 feet of soft brown sandstone sampled.

F–34 Uniontown sandstone. James Buck quarry (114), 1 mile southwest of Rush Run School on the west bank of Rush Run, Luzerne Township; 15 feet of thin-bedded, micaceous sandstone sampled.

F–35. Gilboy sandstone. D. C. Lightley quarry (128), 3 miles south of Merrittstown, Luzerne Township; 15 feet of sandstone sampled.

F–44. Waynesburg sandstone. Israel Voorhis quarry (28), 1½ miles north of Rowes Run, Jefferson Township; 25 feet of massive, coarse-grained, gray-brown sandstone exposed.

F–33. Waynesburg sandstone. John Horner quarry (116), ¼ mile west of Ormond, Luzerne Township; 20 feet of gray-brown sandstone sampled.

F–14. Waynesburg sandstone. Joseph Acklin quarry (123), 1½ miles west of Merrittstown, Luzerne Township; 20 feet of coarse-grained, brown sandstone sampled.

F–39. Waynesburg sandstone. O. R. Elliott Heirs quarry (24), 3 miles northeast of Brownsville, Jefferson Township; 20 feet of massive, gray-brown sandstone sampled.

F–144. Waynesburg sandstone. Frank Gastkill quarry (209), ½ mile north of Bethelboro, North Union Township; 20 feet of sandstone exposed.

F–37. Washington sandstone. Samuel Moore quarry (167), 1.2 miles west of New Salem, German Township; 10 feet of cross-bedded, micaceous, brown sandstone sampled.

F–72. Davistown sandstone. W. G. Higginbottom quarry (133), at Davistown on the National Pike, Redstone Township; 20 feet of brownish, medium-bedded sandstone sampled.

SAND AND GRAVEL

Uses

The sand and gravel deposits of Fayette County have been used in the past to produce material for concrete aggregate and mortar, and some of the purest sand for molding and glass sands. The requirements of sand for use in the manufacture of glass and molding material are given under the section on sandstone and will not be repeated here. For concrete aggregate and mortar the requirements aret not strict and consist primarily of certain characteristics. The hardness of the material is nearly always great enough because only the harder particles are preserved through the river transportation which has formed the deposits.

The color of the sand and gravel are not important. Since organic acids formed from plant remains are harmful to the setting of the cement in concrete aggregate, most terrace and river sands must be washed before being used for this purpose. The rounded shape of most gravel is detrimental to its use in concrete aggregate since round gravel does not promote good bonding qualities; this gravel is usable only in certain kinds of construction unless it has been crushed.

Stratigraphic and Areal Distribution

The unconsolidated deposits of Fayette County are very much younger than any of the hard rock strata and they rest unconformably on nearly all the exposed strata of the county. The oldest unconsolidated deposit of the county is the Carmichaels formation which lies approximately 200 feet above the present drainage levels of the county. The Carmichaels was laid down by the ancestral rivers of the main drainage of the county in the entrenched meanders which have since been abandoned. It is Pleistocene in age, and ranges from 200 feet above the rivers down nearly to the present flood plains. Occasional sand and gravel terraces are found along the river valleys. The age of these terraces is Pleistocene, although it is possible that some of the lowest of them may extend into Recent time. The greater part of the beds of the Monongahela and Youghiogheny rivers, and of the major tributaries of these rivers are choked with sand and gravel deposits of Recent age.

CARMICHAELS DEPOSITS

The Carmichaels are the oldest unconsolidated deposits in Fayette County. They are composed of gravel, sand, silt and clay and are in abandoned meanders of the Monongahela and Youghiogheny rivers. They are differentiated from the latter terrace deposits by their greater elevation above drainage and by the characteristic appearance of the meanders which they occupy. The material of the deposits is extremely varied and except for the basal bed of coarse gravel and boulders, no sequence of position is discernible in the deposit; rather the character of the material seems to have been determind by the vagaries of stream flow. The deposits are 60 to 80 feet thick in a few places, but commonly are thinner. They lie in the bottoms of abandoned channels and may extend up the flanks as far as 100 feet above the bottom.

The deposits are located along the two main rivers of the county. Along the Monongahela River the major deposits are south of New Geneva, at Masontown, at Brownsville, Marchandsville, Fayette City, Fairhope, Lynwood, Belle Vernon. Along the Youghiogheny River they occur at Sitka, South Connellsville, Connellsville, New Haven, Dawson, East Liberty, Perryopolis and south of Banning. Besides the larger deposits mentioned above, there are several small patches of gravel on steep hillsides which probably belong to this deposit.

Sand and clay are the two mineral resources contained in the Carmichaels formation. The clay has been discussed in the section under clay and shale and will be omitted here. Sand has been produced from the Carmichaels for two purposes, the manufacture of glass and molding sand. No Carmichaels sand has been produced for a great many years in Fayette County. Formerly it was produced at Belle Vernon, Perryopolis and a few places along the Monongahela River. More recently molding sand has been obtained from the Carmichaels at Perryopolis.

East of the village of Perryopolis, Guiler and J. K. McIntire stripped about 8 acres to obtain molding sand. More recently J. K. McIntire has been producing this sand from two pits, an upper and lower. The face of the upper pit is 8 to 9 feet high and shows three distinct parts, sharp sand above and below with bonded sand in the middle. The whole thickness is used. The face of the lower pit ranges from 6 to 12 feet and in some places is almost clean sand; elsewhere there may be 3 feet of fine sand, 4 feet of cobbles and boulders resting on 5 feet of coarse cross-bedded sand. The cobbles and coarse gravel are discarded and the rest of the deposit is shipped. Two samples (695, 696) have been collected, one from each of the McIntire pits. Analyses made from them are given below.

TERRACE DEPOSITS

Small deposits of sand and gravel lie along the valleys of the main streams in Fayette County at elevations between the Carmichaels deposits and the flood plains. These are grouped together here as terrace deposits. Unlike the Carmichaels, the terrace gravels are not confined to the area west of Chestnut Ridge, but along the bank of the Youghiogheny River in the Ohiopyle Valley and in the gorge through Laurel Hill. The deposits are roughly stratified gravel mixed with coarse sand. It seems probable that the greater part of the material is reworked Carmichaels deposits and that only a small part of it has been brought down by the rivers from the mountains upstream.

At only one place in Fayette County are these gravels being dug. A. C. Edwards has a fairly large operation at Broad Ford which produces molding sand primarily, but he sells common sand and gravel also. An analysis of the natural-bonded molding sand from this pit (694) is given below.

*Tests of natural-bonded molding sands, Perryopolis, Fayette County**

Lab. No.	Grade or use	Screen analysis												Water percent	Bond strength	Permeability	Compression lbs. per sq. in.	Tensile strength lbs. per sq. in.
		On 6	On 12	On 20	On 40	On 70	On 100	On 140	On 200	On 270	Thru 270	Clay	Total					
695	Bonded			.76	4.44	14.70	16.30	11.60	7.24	7.90	12.24	24.30	99.48	6.2 8.3 10.6 11.7	231 268 249	18.4 23.4 36.0 6.7	11.2 10.9 8.3	.58 .65 .58
696	Core	4.76	3.54	6.16	28.44	20.58	5.78	3.44	1.90	2.68	4.80	17.90	99.98	7.1 8.9 11.5	266 275 250	148 178 79	11.9 9.7 7.3	.97 .87 .52
692	Iron pipe		.94	1.60	16.24	34.60	14.74	7.30	3.00	3.10	4.24	14.40	100.16	4.3 4.8 6.8 9.1	200 224 206 147	72 87 122 102	7.5 10.1 6.8 4.9	.52 .52 .42 .35
694	Gray iron	4.00	1.10	.96	12.74	26.84	14.70	8.20	3.88	4.10	6.84	15.86	99.22	4.6 6.7 8.9 10.3 13.5	201 219 197	25.8 38.0 58.0 93.0 1.1	11.1 9.1 7.0	.58 .48 .42
699	Undeveloped		Tr.	Tr.	4.60	20.30	15.70	11.80	7.44	7.48	10.54	21.60	99.46	4.4 6.5 8.7 11.3 12.7	205 229 200	16.7 58.0 58.0 62.0 30.0	9.7 8.0 7.4	.48 .48 .32

*Stone, R. W., and American Foundrymen's Association, Molding Sands of Pennsylvania: Topo. and Geol. Survey of Pennsylvania, Bull. M11, p. 80, 1928. 695, 696—J. K. McIntire; 692, 694—A. C. Edwards; 699—Dunbar Corp.

ALLUVIUM

Along the courses of the Monongahela, Youghiogheny and Cheat rivers, as well as along Indian, Jacobs, Redstone, and Dunlap creeks, there occur deposits of sand, gravel and silt. In places these deposits are occupying the flood plains of the streams, but in others they are sufficiently high above the stream to form terraces. The material ranges from fine silt and mud to coarse gravel.

Molding sand has been produced from these deposits along the Youghiogheny River. A. C. Edwards operated a pit at the end of First and Second Streets, North Connellsville, where a few acres have been stripped. Further quarrying was stopped because the remaining sand lies under built-up areas of Connellsville. Guiler & Torrance have stripped a similar area in West Connellsville across the river from the Edwards pit. Small amounts of molding sand have been produced farther down the river at Dawson and Layton. Analyses of the molding sands from the Edwards plant (692) and a prior pit of the Dunbar Corporation at Stone Hill, 5 miles east of Dunbar on the Youghiogheny River (699) are given above.

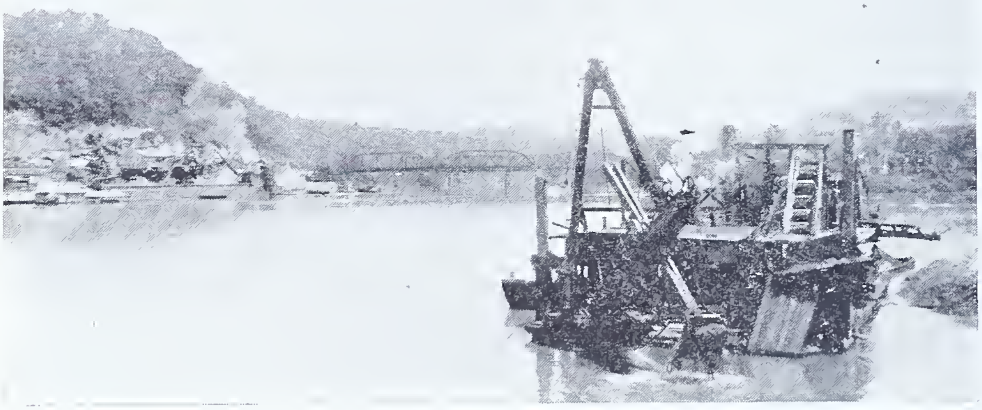

Figure 146. McClain Sand Co. dredge, Monongahela River at Point Marion.

Large amounts of building sand and gravel have been produced from the alluvial deposits. The largest operation is on the Monongahela River at the junction with Cheat River. The plant across the Cheat River from Point Marion obtains sand and gravel by dredging in both rivers. Owing to the canalization of the Monongahela River and the hydro-electric dam on the Cheat River, gravel is no longer washing down these rivers and only 10 to 15 years' supply is left in the river. The McClain Sand Company, which operates this plant, produces 150,000 tons a year on the average, with a peak production of 250,000 tons. About two-thirds of the sand and gravel produced is shipped down the Monongahela River by barges. The rest is shipped over the Baltimore & Ohio Railroad, which has a siding at the plant, and by truck to near-by points. Besides this one large operation, several small ones have sprung up on various deposits along the rivers and streams from time to time. One of these was along Indian Creek, about 1 mile south of Whites bridge where the Baltimore & Ohio Railroad crosses the creek. At the time of this report the plant had been abandoned for some years and was out of repair.

IRON ORE

General Account

In the early history of Fayette County, iron ores were extensively mined and used in the old charcoal furnaces, and later in local coke furnaces. For the last 25 years or more, the local furnaces have not used Fayette County ores, and in fact most of the local furnaces are no longer operating. Therefore, the iron ore horizons that were once well exposed, at present are largely concealed. The iron ore industry of the county reached its height during the time of the Second Pennsylvania Geological Survey. J. J. Stevenson gives a complete record of the old mines, furnaces and sections of the ore beds in his reports KK and KKK, 1877 and 1878. In many respects his record is much more complete than it would be possible to obtain at present. A summary will be given, attempting to correct his errors of correlation.

Two principal types of iron ore have been mined in Fayette County. The most important was carbonate ore which at its outcrops had weathered into limonitic or brown iron ore. The second type was hematite. These ores are sedimentary in origin and were formed as an integral part of the rock strata. The carbonate ores are of two types; one in which iron siderite (iron carbonate) nodules are imbedded in shale and clay; the other in which limestone beds have been replaced by iron carbonate, probably at the time of deposition. In a few places iron limestones seemed to be enriched at the surface, but commonly the iron content diminished only slightly when the ore beds were followed underground.

Stratigraphy

Since the iron ores in Fayette County are sedimentary in origin, they occupy definite places in the sedimentary sequence. In general there are six ore-bearing horizons. They may be enumerated as follows: Pittsburgh, Mahoning, Freeport, Brookville, Mercer and Mauch Chunk ore groups. Stevenson (1877 and 1878) gives only five, having omitted the Mercer group. He misinterpreted the position of the Mercer ores, calling them all Mauch Chunk and considering the Homewood sandstone to be the whole of the Pottsville series.

Individual Ores

PITTSBURGH ORE

The Pittsburgh ore lies below the Pittsburgh coal and above the Little Pittsburgh coal. Owing to the extensive stripping of the outcrop of the Pittsburgh coal, little was seen of the strata lying immediately below the coal during the field work for this report, and so a generalized section made many years ago by Stevenson* is given:

Pittsburgh coal bed	
Clay	2′ to 8′
Blue lump ore	1′ to 6″ to 0″
Clay	1′ 6″ to 4″
Condemned flag ore	1′ to 0″
Clay	2′ 6″ to 4″
Big Bottom ore	1′ 8″ to 1′
Clay	5′ to 10″
Red flag ore	2″ to 6′
Clay	3′ to 1′
Yellow flag ore	4″

This ore is well developed along the Monongahela River around New Geneva and Point Marion, from which place it extends across the Fayette anticline to the vicinity of Fairchance. Its presence is recorded along both sides of the Uniontown syncline in the southern part. On the western side it extends as far north as the National Pike, and on the eastern side it extends to the Youghiogheny River. The ore horizons have been explored as far as 700 or 800 feet underground and diminish little in quality to that point, so it seems probable little surface enrichment has taken place. A few thin ore beds are scattered through the Conemaugh series below the Pittsburgh ore. They are local in character and have never been of any importance.

Analyses of Pittsburgh ore

[A. S. McCreath, analyst*]

	1.	2.	3.	4.	5.	6.	7.
Iron, metallic	33.350	39.000	42.116	35.500	35.800	35.400	29.200
Sulphur	.155	.011	.041	.145	.047	.319	.415
Phosphorus	.072	.089	.070	.042	.083	.069	.268
Insoluble residue	13.860	5.790	4.415	7.450	9.560	10.450	19.240

*Op. cit., pp. 113-116.

1. Near New Geneva, Nicholson Township.
2. Oliphant Furnace, Georges Township.
3. Dr. Fuller's property north of Oliphant Furnace, Georges Township.
4. Oliphant Furnace, Georges Township.
5. Lower benches of ore in South Union Township.
6. Lower benches of ore in South Union Township.
7. Lemont Furnace, North Union Township. D. McCreath, analyst.

MAHONING (JOHNSTOWN) ORE

The Johnstown ores generally occur at two horizons, one directly above the Mahoning sandstone and the other slightly higher in the section. It is probable that they represent ferruginous phases of the two Mahoning limestones. In places the ores occur as solid beds, but more commonly they are merely carbonate or limonite nodules in shale or clay. At some places they are entirely missing from the section. Mahoning ores outcrop at several places along the west face of Chestnut Ridge and in Indian Creek Valley east of the ridge. Their presence was noted above the Lower Mahoning sandstone at Somerfield east of Laurel Hill. These ores have been mined at Lemont

---

*Stevenson, J. J., Penna. Second Geol. Survey, Report KK, p. 111, 1876.

Furnace, South Union Township; Fairchance Furnace, Georges Township; and Springhill Furnace, Springhill Township. East of Chestnut Ridge a small amount of ore was produced from the Springfield mine, Springfield Township, and from the Stewart mine, on Meadow Run, Stewart Township.

*Analyses of Mahoning ore**

	1.	2	3.	4.	5.
Iron	32.02	18.000	11.100	3.49	5.04
Sulphur	.....	0.026	0.313	....	....
Phosphorus	0.20	0.261	0.018	0.12	0.19
Insoluble residue	9.85	18.190	26.090	52.35	21.25

*Op. cit., pp. 120, 121.

1. Lemont Furnace, North Union Township. Prof. Chandler, analyst.
2. Lemont Furnace, North Union Township. D. McCreath, analyst.
3. Simons, South Union Township. A. S. McCreath, analyst.
4. Fairchance Furnace, Georges Township. Prof. Chandler, analyst.
5. Springhill Furnace, Springhill Township. Prof. Chandler, analyst.

FREEPORT ORE

The Freeport ores lie at two widely separated horizons; the upper at the horizon of the Upper Freeport limestone, and the lower at the Johnstown cement bed. The Upper Freeport horizon is more important west of Chestnut Ridge and the Johnstown more important east of the ridge. These ores are largely surface ores. They are limonite at the surface, but become very lean carbonate where sufficiently far underground. It seems probable that a large part of the iron in these ores has been precipitated from surface waters by the limestones. The Upper Freeport limestone ore has been mined on Jacobs Creek in Tyrone ownship and near Dunbar Furnace, Springhill Furnace, and on Deckers Creek, West Virginia.

The Johnstown cement bed ore has been mined at Furnace Run and Springhill Furnace, Springhill Township.

Analyses of Freeport ore

	1.	2.	3.	4.	5.	6.	7.
Iron	31.23	4.21	26.500	40.750	28.300	33.900	38.100
Sulphur	.....	....	.090	0.278	0.079	.333	.159
Phosphorus	1.04	0.01	.046	0.229	0.137	.302	.115
Insoluble residue	16.92	3.85	13.810	5.120	13.885	18.690	9.250

1. Upper Freeport outcrop ore, Springhill Furnace, Springhill Township. Prof. Chandler, analyst.
2. Upper Freeport underground ore, Springhill Furnace, Springhill Township. Prof. Chandler, analyst.
3. Upper Freeport ore, Jacobs Creek, Tyrone Township. A. S. McCreath, analyst.
4. Upper ore, Jacobs Creek, Tyrone Township. A. S. McCreath, analyst.
5. Lower ore, Jacobs Creek, Tyrone Township. A. S. McCreath, analyst.
6. Johnstown cement bed, Fayette Furnace, Springfield Township. A. S. McCreath, analyst.
7. Johnstown cement bed, Furnace Creek, Springfield Township. A. S. McCreath, analyst.

1-5. Report KK., pp. 122, 123; 6-7. Report KKK., pp. 216, 217.

BROOKVILLE ORE

Two or three thin beds of iron ore lie close to the Brookville coal in the lower part of the Allegheny group. The best iron ore is above the coal and lies either directly on it or 10 to 12 feet above the bed. Ore below the coal is too thin ever to be of value. The ore at this horizon is less than at the other horizons, and even in the time of Stevenson, 60 years ago, had ceased to be mined. At one time there were mines on Mount Creek near the old Vernon mines in Dunbar Township, near Dunbar Creek, near Coolspring Furnace in Union Township, near Springhill Furnace, Springhill Township. This ore has never been mined east of Chestnut Ridge, but traces of it were seen in some of the outcrops near Ohiopyle. No analyses of this ore are available.

MERCER ORE

Several beds of ore are known around the Mercer coals at various distances below the base of the Homewood sandstone. Stevenson recognized these ores west of Chestnut Ridge, but placed them in the Umbral (Mauch Chunk) series. He thought that the massive Homewood sandstone along the west face of Chestnut Ridge comprised the whole of the Pottsville and did not recognize the Connoquenessing sandstone lying below it. The ore beds range from one-half to 1½ feet in thickness and are composed of carbonate ore except at the outcrop where they are limonitic. These ores were the most important of all that were mined in Fayette County and several large mines were developed along the west flank of Chestnut Ridge. The most important of the mines were the Vernon, on Mounts Creek, Dunbar mines on Dunbar Creek, the Lemont mines near Lemont Furnace, the Coolspring mines on Shutes Run, the Fairchance mines east of Fairchance, and the Springhill mines near Springhill Furnace. The mine openings are completely caved so that nothing can be seen at present, but Stevenson gives a section at Vernon mines.

*Vernon mines**

	Ft.	ins.	to ins.
Coal bed		3	6
Sandstone	3		
Clay	1	6	3
Pin ore bed......		3	0
Clay	2	6	
Big Bottom ore bed	1	2	0
Clay	3		
Ore bed		2	

* Op. cit., KK, p. 195.

*Dunbar mines**

	Ft.	ins.	to ins.
Seral conglomerate	70	0	
Coal bed	1		8
Concealed	25		
Little Honeycomb ore	0	4	
Concealed	20		
Big Honeycomb ore	1		0
Clay	2	6	
Coal bed..........	0	6	
Clay	10	0	
Kidney ore	0	10	0
Clay	3		
Coal bed..........	0	4	6
Clay	14		
Flag ore	1		
Clay	4	6	
Coal bed	0	6	
Clay or sandstone..	12		
Big Bottom ore....	2		0
Clay shale	5		
Flag ore..........	0	6	0
Clay, shale and sandstone	50		

Op. cit., KK, p. 187.

*Section at Lemont mines**

	Ft.	ins.	to ins.
Seral conglomerate	Fragments		
Red micaceous shale	20		
Little Honeycomb ore	0	4	
Red micaceous shale and argill. S. st'e...........	20		
Big Honeycomb ore:			
Ore, 0′ 1″ to 2″ Shale, 0′ 10″ Spongy ore, 0′ 4″ to 6″ Shale, 1′-2′ Compact ore, 4″ to 6″	3	3	
Dark red shale....	1		
Coal bed..........	0	2	
Clay	1		
Coal bed..........	0	6	
Red shale	12		
Kidney ore........	0	4	8
Shale	2	4	
Coal bed..........	0	8	

About a quarter of a mile down the tramway, the Big Bottom is mined, and the section continues as follows:

	Ft.	ins.	to ins.
Concealed, about..	4		
Coal bed..........	0	8	10
Fire clay	0	6	
Black coaly shale..	0	6	
Fire clay	5		
Big Bottom, ore and clay........	2	6	

Op. cit., KK, p. 174.

*Section at Fairchance mines**

	Ft.	ins.	to ins.
Coal	1	2	
Clay shale	5		
Little Honeycomb ore		3	4
Clay shale	12		
Big Honeycomb ore	1		
Clay shale	1		8
Coal	1	3	
Clay shale	2		
Kidney ore		8	
Clay shale	3		
Big Bottom ore....	1-2		
Clay and sandy shale	14		
Red belt ore		10	

* Op. cit., KK, p. 142.

*Analyses of Mercer ore**

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Iron	39.77	41.400	35.823	41.000	31.100	32.010	37.440	36.200	35.664	31.200
Sulphur	.....	.184	......	0.191	0.086	......	......	0.107	Tr.	0.253
Phosphorus	0.22	.151	0.030	0.120	0.103	Tr.	0.250	0.154	0.008	0.129
Insoluble residue	12.98	6.430	15.568	6.810	25.960	22.150	12.000	12.980	16.700	21.930

* Op. cit., MM, pp. 127, 129, 131.

1. Big Honeycomb ore, Springfield Furnace, Springhill Township. D. McCreath, analyst.
2. Big Honeycomb ore, Lemont mines, North Union Township. D. McCreath, analyst.
3. Big Honeycomb ore, Dunbar mines, Dunbar Township. D. McCreath, analyst.
4. Kidney ore, Vernon mines, Bullskin Township. A. S. McCreath, analyst.
5. Kidney ore, Jacobs Creek, Mount Pleasant Township, Westmoreland County. D. McCreath, analyst.
6. Big Bottom ore, Springhill Furnace, Springhill Township. Chandler, analyst.
7. Big Bottom ore, Fairchance, Georges Township. Chandler, analyst.
8. Big Bottom ore, Lemont France, North Union Township. D. McCreath, analyst.
9. Big Bottom ore, Dunbar mines, Dunbar Township.
10. Big Bottom ore, Vernon mines, Bullskin Township. A. S. McCreath, analyst.

MAUCH CHUNK ORE

Near the top of the Mauch Chunk series, thin beds of hematitic iron ore are present along the east flank of Chestnut Ridge south of the Youghiogheny River. Most of these beds are only 1 or 2 inches thick and have never been mined, but in the vicinity of Wharton Furnace one of the beds ranges from ½ to 2 feet in thickness and was mined extensively on the Wharton Furnace property. No analyses of the Mauch Chunk ore are available.

LEAD AND ZINC

Galena and sphalerite were discovered many years ago in Victor Hollow, Georges Township. The discovery has been reported on by J. J. Stevenson (KK, p. 109, and KKK, pp. 240-241) and by B. L. Miller (1924, p. 47). These exposures were not seen by the writer of this report, as they are no longer accessible. Stevenson reports that the minerals occur as scales, coatings and films on sandstone beds lying near the middle of the Pocono series. A section of the strata is given by Stevenson and analyses by McCreath.

	Ft.	in.	Zinc	Lead
1. Gray sandstone	1	6	0.016	0.129
2. Mottled fossiliferous sandstone	0	10	0.064	0.129
3. Gray sandstone	1	2	0.024	0.200
4. Similar to No. 2	1	0	0.842	0.321
5. Dark shale	0	8	.....	.....
6. Clay and sandstone	3	.	3.370	0.307

The minerals are present in Nos. 2, 4 and 6. Analysis discredits reports that silver is present in the minerals.

GROUND WATER RESOURCES

Several varieties of ground water conditions exist in Fayette County. This favorable situation is caused by the length of stratigraphic section exposed, the large amplitude of folding and the high topographic relief. In the relatively flat Kanawha section lying west of Chestnut Ridge, springs are small and scarce so that household water is generally obtained from drilled wells. Salty water is usually found at depths exceeding 250 feet and it seems probable that only highly concentrated brines will be encountered at depths greater than 500 feet. However, the static level of the salt water is usually far below that of the fresh-water horizons so that contamination of the potable supplies is not to be expected. Directly in the valleys of the Monongahela and Youghiogheny rivers, saline waters are apt to be encountered within 100 feet of the surface. So far as is known, fresh water does not occur in any stratum below the uppermost salt water aquifier.

In the mountainous section of eastern Fayette County, a thick succession of permeable beds is exposed. On the slopes of Chestnut Ridge and Laurel Hill these beds are commonly saturated with water moving down-structure. This water supplies a large number of springs, many of which have flows of 100 or more gallons per minute except during periods of extreme drought. Springs are abundant through the Ligonier and Turkeyfoot valleys and drilled wells are relatively scarce when compared with the western part of the county. Many potential aquifiers exist in the Allegheny Mountain section and the waters are fresh even where they exist below drainage.

The following stratigraphic units are known to be sources of fresh water supplies in Fayette County:

Dunkard system:
  Washington sandstone
  Waynesburg sandstone

Pennsylvanian system:
  Monongahela formation:
    Waynesburg coal and associated beds
    Waynesburg limestone
    Uniontown sandstone
    Uniontown and Benwood limestones
    Sewickley sandstone
    Fishpot limestone
    Redstone limestone
    Pittsburgh sandstone

  Conemaugh formation:
    Pittsburgh limestones
    Connellsville sandstone
    Clarksburg limestone
    Morgantown sandstone
    Duquesne coal and associated rocks

  Connemaugh formation—Cont.:
    "Pittsburgh Reds"
    Saltsburg sandstone
    Bakerstown coal
    Buffalo sandstone
    Mahoning sandstone

  Allegheny formation:
    Butler sandstone
    Westernport sandstone
    Lower Kittanning clay and associated beds
    Kittanning sandstone

  Pottsville formation:
    Homewood sandstone
    Connoquenessing sandstone

Mississippian system:
  Pocono series:
    Burgoon sandstone
    "Murrysville" sand

Among these formational members, the sandstones constitute the dominant source of ground water. In other types of rock, the water occurs in joint and bedding plane conduits of small magnitude where the beds are not deeply buried, but is usually not obtainable where the beds pass beneath thick continuous cover. The Homewood sandstone of the Pottsville formation is probably the most consistent water-bearer, as its texture and permeability are relatively uniform over extensive areas. In the Allegheny formation, the sandstone members are rather conspicuous aquifiers at places, but they vary greatly in permeability and hence are frequently the source of variable quantities of water. The sandstones of the Conemaugh formation are productive over extensive areas, but vary greatly in water-yielding capacity because of changes in permeability. The best aquifiers in the Monongahela formation are the sandstone members in the lower half. Moderate amounts of water are obtainable from the limestone beds of the formation. In the Permian system, only the Waynesburg sandstone has a high water-carrying capacity over large areas. Artesian conditions exist in the more highly folded rocks of the eastern part of the county.

Although coal mining has been carried on extensively in the western part of Fayette County, the overlying roof-rocks have not caved over large areas. Hence, the beds of the Permian system and the Monongahela formation retain their normal water-bearing properties, but being for the most part above drainage level, are uncertain source beds of small water-yielding capacity. Locally, subsidence has occurred and failure of wells and springs has resulted from drainage of the water-bearing beds. The rocks that underlie the coal yield little or no water where they lie beneath continuous cover, a fact which has made it difficult to obtain adequate water supplies at many communities and has led to the construction of an extensive system of mains for the distribution of surface water. Several towns in the western part of the county obtain water from surface streams.

The following analyses of representative samples show the chemical character of the ground waters of the county. Waters from each formation vary between wide limits of concentration and hardness. Also, the relative abundance of the dissolved constituents does not vary systematically according to the formation. The differences in chemical character of the water appear to depend most directly upon the depth of the aquifier beneath the surface, and to a less degree upon the lithologic character of the water-bearing bed.

Analyses of representative waters in Fayette County

[Analyses by U. S. Geological Survey]

No.	Description	Temperature (°F.)	Analyst	Silica (SiO$_2$)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate radicle (HCO$_3$)	Sulphate radicle (SO$_4$)	Chloride radicle (Cl)	Nitrate radicle (NO$_3$)	Total dissolved solids at 180° C	Loss on ignition	Total hardness as CaCO$_3$[1]
567	Fayette City, 1½ miles southeast of. Drilled well 5⅝ inches in diameter and 34 feet deep; water from Lower Pittsburgh limestone; owned by George Bedner	52	F	13	[2].55	128	27	28	3.2	384	116	42	.15	565	10	431
569	Perryopolis. Drilled well 5⅝ inches in diameter and 80 feet deep; water from soft shale at horizon of Clarksburg limestone; owned by John Armstrong	52	F	14	[2]1.0	50	26	8.4	2.0	106	9.9	54	100	304	13	232
570	Perryopolis, ⅓ mile south of. Drilled well 4¼ inches in diameter and 130 feet deep; water from Morgantown sandstone (?); owned by Jack Flannagan	54	F	14	.15	4.4	2.1	93	2.5	[3]253	3.1	13	.0	256	1.5	20
576	Connellsville, 1¾ miles northeast of (Coalbrook community). Drilled well 5⅝ inches in diameter and 40 feet deep; water from Connellsville sandstone; owned by J. E. Henderson	54	F	12	.17	80	20	51	9.6	161	88	58	136	532	22	282
577	Connellsville, 1¾ miles northeast of (Coalbrook community). Drilled well 5⅝ inches, 100 feet deep; water from shaly facies of Morgantown sandstone; owned by Clark Balsley	52.5	F	13	[2]1.1	5.6	2.4	176	2.6	[4]481	10	4.0	1.0	460	2.1	24
578	Melcroft. Drilled well 4¼ inches in diameter and 58 feet deep; water from Worthington (U. Kitt.) sandstone; owned by Melcroft Coal Co.	52.5	F	9.0	[2]5.2	18	7.6	14	1.4	110	6.8	5.7	.10	106	1.8	76
589	Connellsville. Drilled well 8 inches in diameter and 150 feet deep; water from Saltsburg sandstone (?); Yough Brew. Co	52	F	3.9	.19	17	3.0	5.0	.9	28	30	4.0	3.8	83	2.1	55
606	Lemont Furnace, 1¼ miles southeast of. Cool Spring; water from Connoquenessing sandstone; owner, Uniontown Boro.	52	F	8.6	.16	25	4.1	.9	.6	63	22	2.5	1.9	98	1.7	79
617	Fairchance, 1¼ miles northeast of. Drilled well 5⅝ inches in diameter and 165 feet deep; water from Morgantown sandstone; flowing well at former Wynn coke plant of H. C. Frick Coal Co.	53	F	17	.10	36	11	30	1.6	219	17	4.5	.0	216	2.3	135
628	Point Marion, ½ mile south of. Drilled well 8 inches in diameter and 300 feet deep; water from Saltsburg sandstone at depth of 165 to 177 feet; owned by Point Marion Ice Co.	------	F	12	[2].23	31	9.8	114	2.6	224	80	60	13	433	6.0	118
633	Farmington, 1½ miles northwest of. Drilled well 5⅝ inches in diameter and 80 feet deep; water from Mahoning sandstone; owned by William Burley	52	F	7.9	[2].41	68	18	3.8	.6	223	26	12	20	262	6.7	244
635	Farmington, ⅔ mile southeast of. Drilled well 5⅝ inches in diameter and 393 feet deep; water from Homewood sandstone; owned by Gorley's Lake Hotel	51	F	9.1	[2].32	34	10	1.0	2.2	135	7.1	2.1	3.2	132	3.1	126

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[1] Calculated.

[2] Includes iron precipitated at time of analysis.

[3] Includes equivalent of 8.9 parts of carbonate (CO_3).

[4] Includes equivalent of 54 parts of carbonate (CO_3).

Brines

Many years ago salt water was produced from the Pottsville sandstone in the western part of Fayette County. The water after evaporation was said to yield an excellent quality of table salt. This industry ceased to exist so many years ago, however, that little or no data are available on the character of the brine or the amount of salt contained therein. It is probable that the salt was in low concentration, making its extraction expensive. It seems doubtful if a revival of this industry will ever take place, as supplies of highly concentrated brine and mineral rock salt are quite abundant in neighboring states.

Mineral Springs

Several iron springs are known in Fayette County, but only one of these has ever received much notice. It is the Fayette spring, which is situated at the east base of Chestnut Ridge just south of the National Pike near the crossroads of that name shown on the topographic map of the county. This spring was once well known and patronized during the summer by many visitors. At one time several buildings here housed guests, but as long ago as 1875 they had been abandoned, and from that time on the spring has not been used as a health resort.

F. A. Genth[1] analyzed water from this spring as follows:

In one gallon of 231 cubic inches it contains:

Sulphate of magnesia...	0.25472	Bicarbonate of lime.....	9.33441
Sulphate of lime.........	0.05542	Phosphate of lime.......	0.04822
Sulphate of soda	0.19965	Alumina	Trace
Sulphate of potash......	0.11525	Silicic acid	1.19690
Chloride of sodium......	0.08522	Nitrous acid............	Trace
Bicarbonate of iron.....	1.06709	Carbonic acid, free......	0.38284
Bicarbonate of manganese	0.04795		
Bicarbonate of magnesia	1.53414		14.32181

Stevenson thought that this analysis does not represent the full iron content, but that much of the iron had precipitated before the water was collected.

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[1] Op. cit., KKK, p. 243.

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